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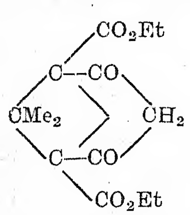
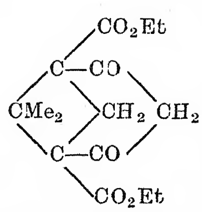
Errata.

Page 53, column 2, Formula I.

For  read 

Page 95, column 1, lines 32, 33, 35 and 37, *for* "μ" *read* "$m\mu$".

Page 287, column 1, line 1, *for* '*Castronodus strassenii*' *read* '*Gastronodus strassenii*'.

Page 288, column 2, lines 22 to 25, *for* "The cervical papillæ....anterior end (Fig. 1)" *read* "The excretory pore in the male measuring 30 mm. in length is at a distance of 1·16 mm. from the anterior end (Fig. 1.)"

Page 288, column 2, Fig. 1, *for* "Anterior end ....papilla" *read* "Anterior end of male showing the excretory pore."

Page 290, column 1, line 10, *for* "M. B. Mirza" *read* "M. B. Mirza and Satya Narain Singh."

Page 435, *Magnifications*.—Fig. I, *for* "×79" *read* "×32"; Fig. II, *for* "×79" *read* "×32"; Fig. III, *for* "×75" *read* "×31"; Fig. IV, *for* "×75" *read* "×31"; Fig. V, *for* "×30" *read* "×12"; Fig. VI, *for* "×20" *read* "×7"; Fig. VII, *for* "×20" *read* "×8".

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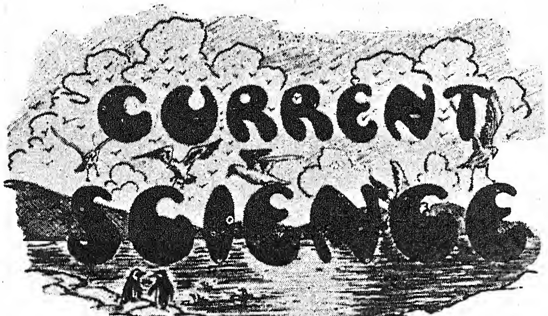

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CONTENTS.

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A Society for the Protection of Game in South India.

WE extend our enthusiastic support to the proposals for the establishment of an association for the preservation of wild life in South India. It seems to us that the adoption of measures for the protection of fish is equally imperative. With the exception of the United Provinces the other parts of India do not have a central organisation commanding sufficient prestige to impose restraints on the indiscriminate slaughter of wild animals, some of which have been brought to the verge of extinction. As an instance of the grievous loss which science has sustained through the uninstructed zeal of sportsmen, we may mention the case of the Dutch settlers in Mauritius, who taking unchivalrous advantage of the half-fledged wings and short legs of Dodo (*Didus ineptus*), succeeded within a comparatively short time in clearing the island of this extremely interesting and rare pigeon. In the interests of science and wider humanity, enlightened governments have recognised the need of imposing restrictions, by the promulgation of game laws and other protective regulations, on the excesses of sportsmen and native shikaris. Wherever there is abundance of sylvan fauna, the temptation for the free use of fire arms becomes irresistible and epidemic and in the excitement, it is not uncommon for men to forget all the commandments both divine and human. The unassisted efforts of government are not adequate to meet the exigencies of the case, and they have to be supported by private associations whose influential position in public life ought to invest them with authority for exerting control on the destructive proclivities of sportsmen and ignorant native shikaris.

From Helen of Troy down to butterflies, the wearer of beauty has always been subjected to persecution and for the gratification of human vanity or pleasurable excitement or under pretexts of protection of human life and crops, large numbers of animals are annually killed, which in minds not sportively inclined evoke feelings of kindness, sympathy and admiration. Attributes such as strength, courage and dignified independence which embellish man's character confer no immunity upon lower animals possessing them. Departure from the doctrine of *Ahimsa* and the impact of

historical influences have diminished in India reverence for animal life and in the next phase of human progress it is hoped that our concept of the sanctity of life, occurring in the Amoeba or the Archbishop of Canterbury will receive a new orientation. But the urgent need is a complete revision of the ethics of sport as pursued at present. We cannot discover heroism, much less righteousness and fairplay, in enticing animals by playing cruelly on the most fundamental and universal appetite, paralysing them with the dazzling brilliance of torchlight and shattering their shoulder blades by firing with magazine rifles from an elevated place of concealment. Compared with this the mode of hunting the offending lion practised by the African tribes has all the good qualities of sport giving, as it does, the hunted beast all reasonable chances to escape and making the hunters oppose skill, strength and daring to the fury of the animal in a battle royal. In a sport it is unmanly to evade the risk and secure the spoils in a manner other than by courage. We have to humanise sport. We should not countenance slaughter without provocation.

The principal offence for which the wild animals are hunted down is that they become dangerous to man and the cattle in his service and to the crops that he raises. Some of them destroy valuable forest produce and a few are reported to increase in population periodically endangering the safety of villages. A few more have the misfortune to possess bright plumage, soft fur, bright skins and succulent meat. Frequently, however, not for any of these provoking causes, wild animals incur the fatal displeasure of man because they provide him with recreation and excitement. To a large extent man is directly responsible for the homicidal tendencies of the more ferocious animals and for the depredations of others on cultivated lands. The former have to be outlawed. But the produce of the land is amply protected from elephants and boars, when the area is surrounded by a deep moat. The population of animals is under the operation of the inexorable physical laws of nature which maintains a balance of power among them, and reports of overpopulation are based on casual observations of herds which driven from their natural haunts by drought or flies, appear in the vicinity of villages. Human pleasure need not necessarily depend on the painful death of lower animals but may be derived from contests offering opportunities for displaying skill, strength and endurance. Occasions might arise when the wild animals, after becoming a source of danger to man and all his belongings, refuse to be dislodged from the positions they have taken up and in such cases they have to be captured alive and added to the zoo. It seems to us that forests are to be treated as fertile recruiting grounds for periodic enrichment of the zoos, parks, museums and other public places of amusement and instruction, instead of being used as a field of infernal carnage.

The Association, when it is formed, will be confronted with a very difficult and delicate task, and without anticipating its functions, we may point out that if it is to serve the high purpose for which it is founded, its activities ought to be continuous and wide-spread. Through a great deal of propaganda work, the Association will have to acquaint the people in general and the shikari section in particular that the interests of science and the cause of deeper humanity forbid the indiscriminate slaughter of animals however ferocious, and irrespective of the amusement their death may provide. The game laws and protective regulations have to be popularised and the Association should publish periodically complete and correct accounts of the life habits and the distribution of the larger denizens of the forest and the economic uses of conserving animal life. A beginning is to be made in the rural schools where infants ought to be encouraged to tend pet animals and grown-up children should be taken out on excursions for observational studies. The habits of animals in our immediate surroundings exercise a great fascination on our mind and the sympathies early contracted restrain the development of destructive tendencies. Children in the urban areas ought to be taken out periodically to the zoos which, if stocked with a representative and rich collection of animals, must provide, under competent guidance, many a useful and intelligent lesson on animal colour, classification, bionomics, ecology and geographical distribution. Frequent visits consolidate the early sympathies formed in the elementary schools and tend to keep the heart warm for the animals. More important perhaps than all this is the education of the villagers. They should be made to realise that the safety of their cattle depends on their keeping them in a perfect phalanx on

the grazing ground and that the cattle and goats entering the reserve sections of the forests attract the tigers and panthers which, emboldened with the success of their adventure, will realise that it is easier to strike down the domestic animals than chase the deer. In trying to rescue his cattle from the clutches of their enemies, the villager succeeds in injuring them and the result of all this is to convert a forest dweller into a prowling village thief. Elephants, pigs, bisons, deer and antelopes can be successfully kept out of the cultivated grounds by a trench which, besides serving as a barrier, will help to conserve the moisture in the subsoil that is so essential for the prosperity and fertility of the lands. This is an expensive and laborious task and the slack season in agriculture will provide the necessary time, and labour may be secured on a co-operative basis. Even if it were desirable, it would be impracticable to suggest that wild animals should not be killed for their flesh, but energetic measures will have to be taken by the Association that all such activities are limited to a single definite purpose and that in no case the permission granted is abused. The administration of game laws is always fraught with difficulty and in some cases even with danger. The active co-operation of the planters and native shikaris will have to be enlisted by the Association in the enforcement of the government regulations and the powers of forest officers should be enlarged to deal with cases of violation of the rules.

It must not be forgotten that the present age delights in sensational thrills and excesses, and measures the merit of things by their advertisement. People have a more touching faith in the "sanctity of broken records" than in the enduring value of work done in solitude and tranquillity. Hunting either for obtaining pleasure or for establishing new records must be deprecated. It will have to be resorted to only for the removal of evil. The aim of the Association should be to encourage the study of the habits of wild animals in their native haunts, their interdependence in the economy of nature, their adaptive modifications, their evolutionary history, their jealousies, affections and antipathies, their social instincts and crude forms of patriarchal government among gregarious forms and all those features of unsophisticated wild life which instruct the human mind and ennoble its sympathies.

The Association will have to treat this task as a humanitarian mission, the reward for its successful and satisfactory accomplishment is the gratification that its members have restrained the reckless waste of animal life whose closer and sympathetic study might furnish clues to an illuminating interpretation of some of the obscure and puzzling psychological and sociological problems of man. In the supreme interest of science, elephants and the South Indian ibex which possess a historical importance should receive special consideration and the Association should regard their protection as its sacred duty. We fully realise the magnitude and the importance of the task which will be assigned to the Association and we hope that its formation will not be unduly delayed. The generous support and enthusiasm which H. E. the Governor of Madras has accorded to the movement and the co-operation which the Association expects from the enlightened Governments of South Indian States offer hopes of success.

Acknowledgment.

WE acknowledge with deep gratitude the generous grant for *Current Science*, of Rupees Three Hundred per annum for three years, by the Government of His Highness the Maharaja of Mysore. That His Highness' Government should have made this grant in the present state of financial stringency is an additional proof of the great sympathy with which they encourage the cause of Science. We are optimistic. We believe that in the near future, other Provincial Governments and Indian States will appreciate our services in an equally handsome manner.

A Review of the Work on Fungi in India.

By Dr. H. Chaudhuri,
Punjab University.

THE number of annual contributions on fungi and plant pathology in recent years has reached such enormous proportion that it is almost impossible for any one person to keep in touch with the various problems connected with this group of plants. Necessarily any attempt to put together the subject-matter of contributions in the course of a few pages, even of the Indian contributors must be a very sketchy one and arbitrary selection of papers has to be made. Investigation on fungi has been carried on in India, till recently by the Departments of Agriculture and Forestry. The work from the latter department has been confined amongst the workers connected with the Forest Research Institute at Dehra Dun, for no Provincial Government in India could claim to possess any properly equipped laboratory for its forest department. But it is not so with the agricultural departments. Besides the Mycological section in the Imperial Agricultural Research Institute at Pusa, the Provincial Governments of Punjab, Bombay, Madras, C. P. and U. P. as well as many of the Indian States possess well-equipped laboratories for plant pathological studies. Research officers of these agricultural departments have to devote their time mostly in the investigation of the diseases of economic plants just as forest officers have primarily to concentrate their work on problems connected with the protection of forest trees. Hence till very recently, investigations on fungi were confined to problems connected with plant diseases only. The field of research work on fungi has, however, been considerably broadened during recent years by the establishment of research departments in some of the Universities and Colleges. Punjab and Allahabad Universities and also the University of Calcutta have well-equipped laboratories and the Carmichael Medical College, Calcutta, Agra College, Agra, and Gujerat College, Ahmedabad, have laboratories for specialised work in fungi. From these University and College laboratories valuable contributions on various aspects of fungi are being made. Besides these centres of research, the work of the Mycological section of the Indian Tea Association deserves special mention. The work of these various research stations will now be briefly stated.

Forest Department.—Earliest papers mostly consist of occasional notes on fungi collected by the forest officers. Thus Cooke (1876–79) described some fungi collected by Gamble. Barclay (1889–92) described some rusts and Nisbet (1895) wrote on cankers and rots, and Gamble (1899) published a note on some Indian fungi. Later Troup, Fernandez, Brandis, Coventry and others published a number of notes on fungi. The credit of a first systematic study of Forest Fungi goes to Butler (1905). Troup investigated *Peridermium cedri* as a destructive pest of Deodars. Hole drew attention to the importance of ecological studies in control of diseases and suggested new fields of research. Spike disease of sandal, which is now classed as a virus disease and work on which is now being jointly carried out by the Indian Institute of Science, Bangalore, and the Mysore State officers, was first reported by Barber (1903). The same year Bensen and later Rao, Lushington, Hole, Jackson, Coleman, Latham, and others have contributed on various aspects of the disease and put forward various theories. Wood-rotting fungi have received special attention. Butler (1903) and later Cooper, Haines, Glover Troop, Trevor and others have worked on it. Hole published his results of his field observations of *Trametes pini* on several hosts. Systematic studies of forest fungi and also inoculation experiments are now being made. Bagchee made careful investigation on the infestations of *Peridermium complanatum* on the needles and *P. himalayens Bagchee*, on the stem of *Pinus longifolia.* A new species of cronartium from the Himalayas has also been recorded by Bagchee. Hafiz Khan investigated coloeosporium and cronartium rusts of forest trees. He also investigated a few root-rot of trees.

The largest number of papers have no doubt been published from the Agricultural Departments of the Government and of the States. The research in mycology and plant pathology in India began with the appointment of Butler as the Imperial Mycologist at Pusa (1905) and it may be safely said that before Butler there has been no research in

Mycology in India. Butler's book *Fungi and Plant Diseases* gives an account of the work done at Pusa on sugarcane, cereals, pulses, fibres, vegetable crops, etc. This book records all the work upto 1918. In addition, work has been done by Butler in collaboration with specialists in Europe, such as Sydow. The major portion of the work done on Indian fungi has been recorded by Butler and Bisby in the *Fungi of India* published by Imperial Council of Agricultural Research as Monograph No. 1 of 1931. This records most of the publications up to 1929. It has got a bibliography and a list of synonyms. Besides numerous papers on plant diseases published by him, Butler has also published an account of the genus *Pythium* and some *Chytridiaceæ*.

Intensive work has been done on the wilt of rahar (*Cajanus indicus*) due to *Fusarium vasinfectum*, by McRae and Shaw. It has been controlled by resistant varieties. Shaw studied diseases of the jute plant and also the morphology and parasitism of Rhizoctonia. Cereal diseases due to Helminthosporium have been described by Mitra and four new species recorded for India. Mitra has recorded a new bunt of wheat—*Tilletia indica*, Mitra. It is interesting, as throughout the world only two species *Tilletia tritici* and *T. Levis* have been recorded. Gram blight due to *Phyllosticta rabiei* (Pass) in the Punjab, has been studied by Luthra. He also investigated red leaf spot of Jowar due to *Colletotricum graminicolum* and found the disease to be seed-borne.

Ajrekar in Bombay studied the mode of infection and prevention of the smut disease of sugarcane and a disease of jowar caused by the conidial stage of Cleviceps. Ajrekar, Bal and Kamat studied the cotton wilt problem. Kulkarni and Mundkar studied the wilt disease of cotton in Dharwar. Various smuts of jowar, ragi and on Sawn have been studied by Kulkarni. Uppal and Kamat brought about artificial infection of Bajra by *Sclerospora graminicola*. The *Sclerosporas* on various hosts in Bombay Presidency have been studied by Uppal, Desai and Kulkarni. Weston and Uppal redescribed as a new species *Sclerospora sorghi* (Kulk.). Uppal found *Sclerospora graminicola* to split into specialised races and that one physiologic form attacked bajri and the other *Setaria* sp., and *Euchlæna muxicana*. Cheema and Bhat studied the dieback of citrus trees and found very good results by manuring and trenching. In the control of Cumin Powdery Mildew, Uppal and Desai found that an application of sulphur (25 lbs. per acre) made at about the time of flowering gave complete control of mildews.

In Madras Presidency McRae studied the life history of *Phytophthora Meadi* n. sp., on *Hevea brasilenses* which reduces the yield of latex by causing heavy leaf fall. Sundararaman described a new ginger disease from Godavari District due to *Vermicularia zingibræ*. He found spraying with Bordeaux checked the disease. Cocoanut stem-bleeding disease due to *Thielaviopsis paradoxa* which ultimately kills the trees has been studied by Sundararaman, who has suggested control by scooping out all the diseased tissues and applying hot tar. This organism also causes the stem-bleeding of areca-nut and treatment is similar. Sundararaman and Ramakrishnan described the Mahali disease of cocoanut due to *Phytophthora arecæ*. Spraying the nuts with Bordeaux before monsoon bursts has been found to control the disease. Sundararaman also studied some Vermicularias of economic importance in the south and the life-histories of *Phytophthora Pini var. Antirrhini* causing foot-rot and wilt of *Antirrhinum*, a smut *Setaria italica, viz., Ustilago crameri* and *Helminthosporium oryzæ*—a paddy disease. Sugarcane mosaic has also been studied and inoculation experiments showed that infection is caused through setts and by insects.

Dastur studied the foot-rot disease of pan in the Central Provinces. The striga disease of jowar and sugarcane has been studied by him. He found treating the infected cane clumps, with copper sulphate, controlled the disease successfully. In the *Anthacnose* disease of the bolls of cotton due to *Vermicularia* sp., Dastur found that addition of sulphur or sodium sulphate to wilt-infected soil had a controlling influence on the incidence of the disease. A new disease of the castor oil plant due to *Phytophthora parasitica* nov. sp., has been described by Dastur. The oogonium of this species in passing through the antheridium, gets fertilized, the latter remaining as a collar at the base of the oogonium. Jiwan Singh studied the *Fusaria* from cotton plants and soils in C.P. and from inoculation experiments, he found that they were incapable of infecting plants though they remained viable in the soil. Regarding gram wilt, Dastur doubts if it is due to any pathogenic organism. The mode of infection of smut by sugarcane has also been studied by Dastur.

From U.P., Dey studied the physiology of the appressorium of *Colletotrichum glœosporioides*, isolated from *Citrus medica* var. acida. He found that stimulated by the substances diffusing out through the cuticle, the appressorium sends out a fine infectious hypha from its adpressed surface which finally ruptures the cuticle mechanically, in a way similar to that found by him in *C. lindemuthianum*.

Besides the Government Agricultural Department, best work from the Indian State Agricultural Departments is, no doubt, from the Mysore State. Coleman has extensively worked on the rot of the Areca Palm and later Narasimhan worked on the same thing. Narasimhan made a study of the genus *Phytophthora* from Mysore. He isolated heterothallic strains of *Phytophthora*. Similar strains of *Phytophthora* from Areca and Aleurites have also been isolated and described by Venkatarayan. Narasimhan has done cytological investigation of the sandal spike-disease and found intercellular bodies associated with the disease similar to those described in other virus diseases. Sreenivasaya from the Institute of Science, Bangalore, worked on the disease transmission in sandal spike.

In Baroda State, Likhite has been working on tomato viruses and other diseases.

In the Punjab University, Chaudhuri and Rajaram made some interesting observations regarding *mycorrhiza* in *Marchantia nepalensis*. The endophyte was isolated and by means of inoculation experiments, a reciprocal symbiosis has been shown to exist. The green plant supplies the fungus with carbohydrates and the specific endophyte is necessary for the formation and maturation of the sporophyte generation. Chaudhuri described a *Myzocitium* growing on *Spirogyra affinis* covering the characteristics of at least three known species of *Myzocitium*. Sawhney worked out a *Capnodium* disease of cotton. Nazir Ahmad studied the dung-fungi of six animals and a large number of new species has been recorded. A large number of soil fungi has also been studied by Singh. Chaudhuri studied the green-ear of Bojra and made successful artificial inoculation and also studied the germination of the oospores. The Casuarina root-nodule organisms have been studied by Chaudhuri and irregular occurrence of the nodules discussed. He also studied a partial wilting of *Hibiscus tiliacens* caused by the staling product of *Alternaria*. Chaudhuri and Gopal Singh studied the wither-tip disease (*Colletotrichum glœosporioides*) of the citrus plants and the effect of the environmental condition on the virulence of the organisms has been shown. Saltation in fungi has been experimentally studied by Chaudhuri and has been found to be a nutritive phenomenon, unless it be a true case of mutation. Chaudhuri and his students studied various diseases of the tea bush, orchards and vegetable crops and also the effect of X-rays and ultraviolet rays on the physiology of certain fungi.

From Allahabad Mitter (J. H.) and his pupils have been working on the fungus flora of that place and also of Naini Tal. Mitter and Tandon have published notes on two fungi isolated from an Indian hill apple and also *Sclerospora graminicola* on Bajra. Mitter in collaboration with Sydow published a paper on Indian Fungi and described a new genus *Mitteriella*. Saksena made interesting observations regarding the cytology of *Pythium de Baryanum*. A study of the comparative values of various fresh fruit juice media on the growth of Fungi Imperfecti has been made by Mitra (A. K.)

At Agra, Mehta has done very interesting work regarding the dissemination of rust spores and incidence of rust epidemic. By means of slides in æroscopes, he has been able to follow the progress of the rust spores and has brought forward evidence of over-summering of rusts in several hill stations and also of over-wintering of brown and black rusts at comparatively low altitudes.

In the Carmichael Medical College, Calcutta, Bose has studied the various aspects of Bengal *Polyporaceæ* and also *Agaricaceæ*. He described a number of new forms. Bose studied the fungi cultivated by the termites of Barkuda. He contributed a paper on Golgi bodies of higher fungi wherein he showed the homology of the vacuolar bodies in the basidia of higher fungi with the golgi bodies in animal cells. Working with monosporous cultures of *Polyporusosteriformis* and *Polystictus hirsutus*, Bose found that both the species are strictly heterothallic and bisexual, in which spores from a single fruit body fall into two groups and only two. These two sexes seemed absolutely stable as they could not be changed by variations of external conditions nor by different kinds of media. From Toklai in Assam, the experimental station of the Indian Tea Association, a large number of important papers have been published by Mann, Tunstall and Tunstall

and Bose. The station is maintained for exclusive study of tea diseases. A very large number of papers have been published by Tunstall on various stem, root and leaf diseases of the tea. He also studied the micro-organisms associated with tea fermentation.

The author is afraid that the above review has been a very sketchy one and works of many of the authors could not be mentioned. Before concluding, he expresses his thanks to many of the authors who helped him with their publications and reports of the work of their departments.

The Occurrence of Mundwinkeldruse in the South Indian Frogs.

By L. S. Ramaswami, B.Sc.,
Department of Zoology, Central College, Bangalore.

UNDER the title "Mundwinkeldrüse" De Villiers has described a gland of problematical function, occurring in the upper jaw of some of the South African anura such as *Anhydrophryne*,[5] *Probreviceps*,[9] and some Ranids. However, in *Breviceps fuscus*[6] which is closely related to *Probreviceps*, he has reported the absence of this interesting gland. This structure is in no way peculiar to the amphibious anura since Fuchs[7] has noticed its presence and discussed its importance among the reptiles.

In *Anhydrophryne*[5] which according to Villiers is almost a Ranid, he has given the following description of the gland: "This glandular structure is located in a groove of the maxillary, its wall is two layered, the inner layer being richer in nuclei than the outer. Histologically the structure resembles adenoid tissue, but it possesses a lumen which opens into the mouth cavity. The organ has a rich blood supply; its innervation was not determined."

The present paper which is the first of the series, embodies the results of an investigation undertaken to determine the topographical relations and the histological character of the maxillary gland situated in the maxillary of some of the South Indian batrachians. Sections of the head of several genera of Ranid and Engystomatid families were made. It is peculiar that there is a great divergence as regards the general shape, occurrence, size and relations with the associated structures of this gland.

There is abundance of evidence in support of the view that the Engystomatidæ constitute a primitive family showing specialisations in certain characteristics produced as adaptive modifications by the extraordinarily peculiar habits of life assumed by them. And even within the limits of a single family there is a great deal of divergence in regard to the general disposition of the gland, but in all the genera examined by me the uniform occurrence of the gland is a noteworthy feature. On the other hand, among the Ranids the study of the slides points to the occurrence of this gland only in *Rhacophorus maculatus* while *Nyctibatrachus* and *Ixalus* are devoid of this gland.

I am indebted to Dr. A. Subba Rao for the *Glyphoglossus* material. I have studied the cranial osteology and conus arteriosus of this form and the results of my investigations will be published soon.

It occurs to me that a close study of the histological details and the relations of this gland in the Engystomatidæ would lead to the splitting of the family into two groups, a procedure which is supported by the investigations of conus arteriosus[3] and the brain[4] and also their cranial osteology.[8] Undoubtedly *Glyphoglossus* represents the primitive member of the group for which I possess evidence and *Kaloula* and *Microhyla* represent a separate group possibly of the same rank as *Glyphoglossus* or slightly higher in the scale of differentiation. *Cacopus* certainly represents a most highly evolved genus.

I shall now proceed to give a short description of the gland in each of the different genera at first and then proceed to discuss the probable line of its evolution. At the outset it should be remarked that the gland in *Glyphoglossus* is most simple and it assumes the greatest complexity in *Rhacophorus*. The other genera *Cacopus*, *Kaloula* and *Microhyla* occupy the intermediate stage and of these, the latter genera *Kaloula* and *Microhyla* are almost identical while *Cacopus* represents a condition which in several respects departs widely from them.

In *Glyphoglossus* the gland, situated below the antorbital cartilage, is a loose mass of adenoid tissue supported by connective

tissue matrix. In general outline the mass is oval (Fig. 1). In the glandular region the antorbital cartilage is invested by the pterygoid and maxillary bones. The gland is richly vascular. Perhaps the most interesting fact connected with the gland in *Glyphoglossus* is that the buccal epithelium enters into the adenoid in the form of two invaginations so that in sections the gland seems to possess two ducts opening into the oral cavity. But the fact is the gland possesses no duct of its own, and the gland itself may be described as an oval cap surmounting, and closely adherent to, the two tubular recesses of the oral cavity.

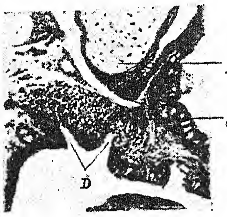


Fig. 1.

The glandular patch below the antorbital cartilage in *Glyphoglossus*.

G.—Gland.
D.—Ducts.
A.—Antorbital cartilage.

It is only appropriate that *Microhyla* and *Kaloula* should be treated together. In both these genera the anterior border of the gland touches the median vertical axis of the eye, and therefore is more posteriorly situated in regard to the antorbital process (Figs. 2 and 3). The hinder border does not reach however the tympanic area in both. The duct opens below the eye into the oral cavity, in other words, well in front of the angle of the mouth. In *Microhyla* histologically we can distinguish an outer cortical and an inner medullary portion, and both regions are richly vascular, and innervated by the maxillary branch of the fifth cranial nerve. The duct part is produced by a single extension of the ciliated buccal epithelium, which is numerously surrounded by mucous glands. (Fig. 4). The glandular tissue of the 'mundwinkeldrüse' does not extend into the region of the duct invested by the mucous glands. In both *Microhyla* and *Kaloula* the glandular cells bear cilia. There is, however, a small difference in the shape of the gland in the two forms. In *Microhyla* it is longer than broad and the reverse is the case in *Kaloula*.

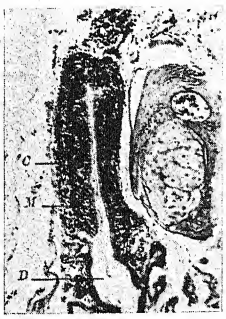


Fig. 2.

The gland in *Microhyla*.

C.—Cortex.
M.—Medulla.
D.—Duct.

In the two forms the duct is composed of columnar epithelium with the nuclei situated terminally. The duct portion receives the secretion of the mucous glands poured through narrow channels. It is curious that at the apex of the gland two or three lymph sacs are present, and some of them are situated in such close proximity as to suggest a physiological relationship between the lymph sacs and the glands. There can be little doubt that the secretion of the gland is voided into the mouth through the ciliary action of the glands.

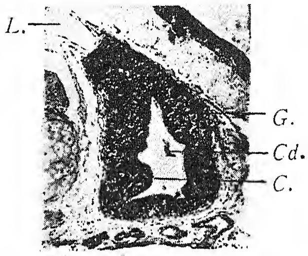


Fig. 3.

The gland in *Kaloula*.

G.—Gland.
L.—Lymph sac.
C.—Cilia.
Cd.—Cellular detritus.

Fig. 4.

The duct and gland of *Kaloula*.

In *Cacopus* (Fig. 5) the anterior border of the gland begins in a line with the anterior margin of the eye but its duct opens into the buccal cavity behind the angle of the jaws. Both as regards its anterior and posterior relationships *Cacopus* differs from *Kaloula* and *Microhyla*. The gland lies freely nearer to the pterygoid and above the maxilla. The gland itself is traversed by a system of lacunæ with well demarcated internal lining and is far more vascular than in the other two preceding genera. Usually the lacunæ contain cellular detritus and stray blood corpuscles, and it is noticed that they open into the lumen of the gland. The duct which is a buccal extension is surrounded by a large number of buccal

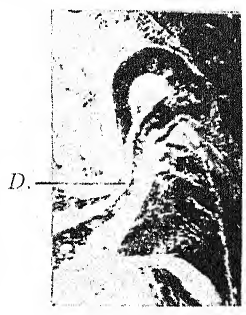


Fig. 5.

The gland in *Cacopus*.

D.—Duct.

glands. Neither the glandular cells nor those of the buccal epithelium of the duct are provided with cilia. In this respect *Cacopus* resembles *Glyphoglossus* and *Rhacophorus*.

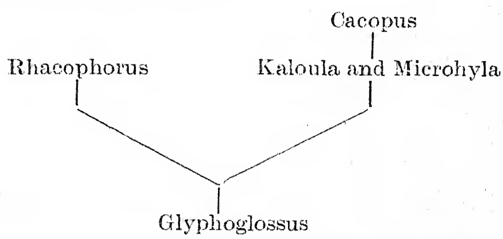
In *Rhacophorus* the gland situated above the maxillary bone has assumed large proportions (Fig. 6). It does not extend beyond the eye in front while posteriorly it touches the tympanic area, though its duct opens well in front of the angle of the jaws. In sections it is noticed that the gland has a large lumen with radiating branches, so that a star-shaped figure is noticed in some of the sections. The vascularization and innervation of the gland are identical with those of Engystomatidæ.

Fig. 6.
The gland in *Rhacophorus*.
G.—Gland.
Ma.—Maxilla.

A suggestion as to the probable line of evolution may be made at this stage. Assuming that the gland has a physiological significance it is noticed that it occurs in its simplest form in *Glyphoglossus* where it is a collection of highly nucleated vascular lymphatic tissue, opening into the buccal cavity by two ducts. It is distinctly antorbital in position, and probably this is the original position of the gland. In the other genera of the Engystomatidæ a backward movement of the gland has manifestly taken place. It has moved far behind in *Kaloula* and *Microhyla* than in *Cacopus*, only in respect of the anterior margin of the gland. The point to which evolutionary modification has taken place is not to be tested by the relation of the anterior border of the gland to the eye but by the position of its opening into the buccal cavity. *Kaloula* and *Microhyla* occupy an intermediate position between *Glyphoglossus* on the one hand and *Cacopus* on the other, which represent the two extreme points in the evolutionary scale. Further, while the gland retains its maxillary relation in *Kaloula* and *Microhyla* as in the case of *Glyphoglossus* it has shifted its position more towards the pterygoid in *Cacopus*.

The presence of ciliated cells in the gland of *Kaloula* and *Microhyla* should be regarded as a secondary feature and cannot have any relation with the origin of the structure which is mesenchymatous uniformly in Engystomatidæ and in other families.

Two available evidences furnished by the larva are in support of this view. In the early tadpole condition, I have studied the patches of loose mesenchymatous cells with darkly staining nuclei surrounded by fine capillaries in the antorbital region of *Cacopus* and *Microhyla*. In these tadpoles usually two glandular patches on each side of the dorsolateral aspect of the gill-arches, which in the sections appear slightly protruding in front of the eyes, can be made out. These patches do not establish at this stage buccal openings but they appear at about the time of metamorphosis when buccal recesses are being formed. When terrestrial habits are completely assumed, the glands acquire adult features. I have not been able to follow the development of the glands in the case of *Rhacophorus*, but from a study of the histological elements and topographical relations of the gland in the adults, I conceive that the line of evolution should have proceeded as in the following sketch which is not to be supposed to have any phyletic significance.



In this connection I may state that the sections of the head of examples of Apoda such as *Uræotyphlus* and *Ichthyophis* which have been studied do not show the presence of such glands. No reference is available as regards the occurrence or otherwise of the maxillary gland in Urodela, and it is difficult to decide whether the glands have any appreciable physiological function among the Anura in which their presence is reported.

I am appending below a tabular statement showing the topographical relations and dimensions of the gland in the forms discussed in this paper :—

Examples	Location	Extension	Size in μ
Glyphoglossus	As a patch below the antorbital cartilage invested by the pterygoid.	Commences before the eye and ends before the anterior limit of the eye.	230
Microhyla	Between the pterygoid and the maxillary.	Commences at a level with the median vertical axis of the eye and extends posteriorly to it. The duct opens well in front of the angle of the mouth.	270
Kaloula	do.	do.	500
Cacopus	Between the pterygoid and the maxillary with the mandible below.	Commences at the anterior extremity of the eye and opens behind the angle of the mouth.	880
Rhacophorus	do.	Commences at the anterior margin of the eye and the duct is seen in the region of the annulus tympanicus, but opens in front of the angle of the mouth.	1060

References.

[1] Ecker, *Anatomy of the Frog*, 1889.

[2] Jolly, *J. Compt. Rend, Biol.*, **71**, 200, 1919.

[3] Narayan Rao, C. R., and Ramanna, B. S., *Proc. Zool. Soc.*, Part 4, 1445, 1925.

[4] Narayan Rao, C. R., *Journ. Mys. Uni.*, **4**, No. 1, 1930.

[5] De Villiers, C. G. S., *Anat. Anz.*, **71**, 331, 1931.

[6] *Ibid., Anat. Anz.*, **72**, 164, 1931.

[7] Fuchs, H., *Nachr. v. d. Ges. der Wis. Zu. Gott., Fachgruppe*, **6**, 131, 1931.

[8] Ramaswami, L. S., *Journ. Mys. Uni.*, **6**, No. 1, 1932.

[9] De Villiers, C. G. S., *Anat. Anz.*, **75**, 257, 1933.

Physical Nature of the Nerve Impulse.*

By Prof. A. V. Hill, O.B.E., F.R.S.

In his Friday evening discourse delivered at the Royal Institution on 10th February 1933, Prof. A. V. Hill has discussed the nature of the nerve impulse, a subject which has engaged the attention of physiologists and which has given rise to much speculation. According to Prof. Hill, "the nerve impulse is an event, a wave, a propagated disturbance, not a substance or a form of energy. It is transmitted along a thread of protoplasm which in medullated nerve is surrounded by protecting or 'insulating' sheath. Its passage can be detected in several ways: (*a*) by its physiological effect on the organ to which it runs, (*b*) by the electric change which accompanies its transmission, (*c*) by the production of heat, and (*d*) by a consumption of oxygen and liberation of carbondioxide." The properties of the nerve impulse are discussed giving the methods of recording the variations that are brought about during the event. Under other effects of oxygen, the lecturer describes the result of the action of certain drugs like veratrine and curare.

The strength, duration, the manner in which excitation by an electric current occurs and the nature of the propagated disturbance are discussed. The factors which determine the excitation time are noted. The difference in the behaviour of different fibres or of the same fibre under different conditions which is due to the alteration in the electrical resistance is explained by the probable specific solubility in the lipoidal substance of the nerve sheath under the influence of potassium ions.

The account of the mito-genetic radiation in nerve on which the Russian school is working is indeed very interesting, if not exciting and if confirmed will gain very great social and industrial importance.

A. Subba Rao.

* *Nature*, April 8, 1933.

Letters to the Editor.

The Multiple Testis of *Ichthyophis glutinosus*.

ACCESSORY testicular lobes have been reported from Urodela, Gymnophiona and Anura and while the origin, nature and significance of these bodies have been subjected to very critical examination in many urodeles and some anura, literature does not show any reference to the multiple nature of the testis in Gymnophiona. Nussbaum[1] who was one of the first to describe the segmented nature of the testis in several species of urodeles, correlated the degree of development of the multiple testis with the time of the year and the age of the animal. Champy[2] thought that the segmented condition of the testis was due to the elongation of the body of the animals. Kingsbury[3] found the lobed testis more common in adults than in young ones of *Desmognathus fusca*. A new explanation of this phenomenon was given by Humphrey[4] who, following Spengel[5] thought that the regular caudo-cranial development of the germ cells and their very slow ripening in many urodeles have resulted in this segmented condition of the testis. It is to be remembered that in most of these cases, especially those examined by Humphrey[4] in between the lobes of the testis an abundance of germ cells is found and no part of the testis is entirely free from them.

In marked contrast with the urodeles is the condition found in the Gymnophiona. As far back as 1876 Spengel[5] noticed the entire absence of germ cells between the segments of the testis. And unlike urodeles even in an immature animal the testis shows segmentation and I have reasons to believe that after a certain age, the number of the testis lobes does not increase in the animal.

Obreshkove[6] in a recent communication on the multiple testis of *Diemyctylus viridescens* gives a different explanation as to the origin of the multiple testis in this animal. He finds the lobed condition even in immature animals and in addition to the regular and connected system of testis segments certain isolated germ cell groups are found, sometimes not in the direct axial line of the germ cord, which have led him to conclude that the multiple condition of the testis in *Diemyctylus viridescens* has arisen from distinct rudiments unconnected with one another. Peritoneal cells are in this animal capable of giving rise to islands of germ cells. This explanation of Obreshkove, though refuted by Humphrey[7] in a later communication, offers, I believe, an approach to the correct understanding of the subject of multiple testis in Gymnophiona. Distinct germ cell proliferations appear independently along the sex cord and these at first are in the nature of solid masses of rounded cells traversed in the centre by a duct. It can be distinctly seen that the germ cells have aggregated to form nests, which, when the testis capsules are formed as outgrowths from the duct, migrate into them.

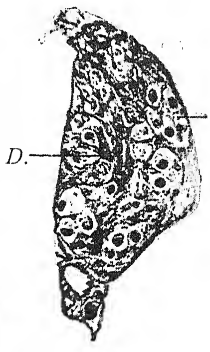


Fig. 1.

Longitudinal Section of a testis lobe of the larva of *Ichthyophis glutinosus* measuring 11·5 cms.

D.—Duct.
G.C.N.—Germ cell nests.

In the latest contribution to the subject of the anatomy of the testes of Gymnophiona, Tonutti[8] reports that in *Hypogeophis*, the anterior testis lobes are generally larger than the posterior ones. He thinks that some of these anterior larger lobes are formed by the fusion of two originally distinct ones. In *Ichthyophis*, however, I cannot make out any such fusion nor can I trace, with definiteness, any regular transitional difference in size between the anterior and posterior lobes. The posterior lobes in many cases are as large as and sometimes even larger than the anterior ones.

It will be recognised that the indefiniteness in the number of the testis lobes in

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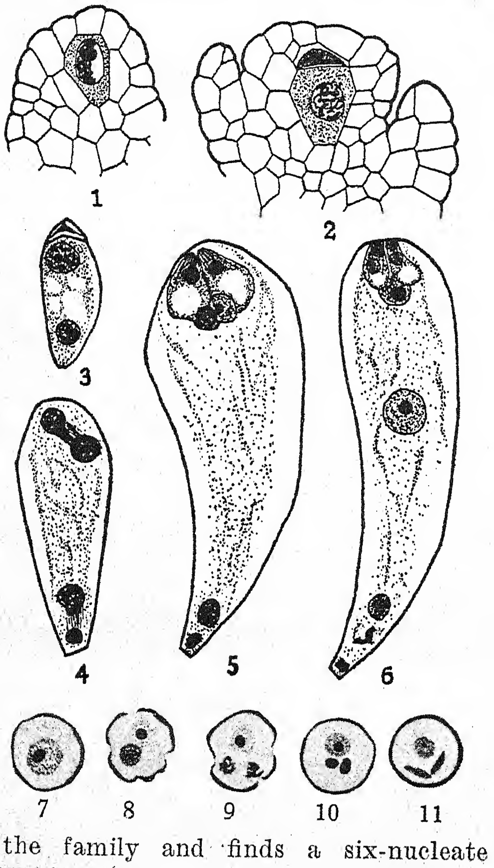
[1] Nussbaum, M. *Arch. fur Mikr. Anat.*, **68**, 1, 1906.
[2] Champy, C. *Archiv. de Zool. Exper. et Gen.*, **52**, 13, 1912.
[3] Kingsbury, B. F. *Amer. Journ. Anat.*, **1**, 1901.
[4] Humphrey, R. R. *Biol. Bull.*, **43**, 45, 1922.
[5] Spengel, J. W. *Arb. aus dem Zool. Zootom*, **3**, 1, 1876.
[6] Obreshkove, V. *Journ. Morph.*, **39**, No. 1, 1, 1924.
[7] Humphrey, R. R. *Journ. Morph.*, **41**, No. 2, 283, 1926.
[8] Tonutti, E. *Morph. Jahrb.*, **68**, 151, 1931.

different animals and on the two sides of the same individual will have to be explained adequately. The factor that determines or influences the development of the individual number of the testis lobes is not known, and it seems to me that individual and lop-sided variations have no specific or physiological significance.

B. R. SESHACHAR.
Department of Zoology,
Central College, Bangalore,
June 27, 1933.

Contribution to the Morphology of *Limnophyton obtusifolium* Mzq.

PLANTS of the family *alismaceæ* have been investigated by several workers, each obtaining somewhat different results from the other. Schaffner worked out *Alisma plantago* in 1896 and *Sagittaria latifolia* in 1897 and reported an eight-nucleate embryo sac. Dhalgren in 1928 worked out *Alisma plantago* and a few other genera of the family and finds a six-nucleate embryo sac.



A considerable quantity of material of *Limnophyton obtusifolium* was collected from Bharatpur to obtain a close series of stages giving the development of the female gametophyte. The flowers are borne in 4-5 whorls on a long peduncle. They are of two kinds either purely male or hermaphrodite. Hermaphrodite flowers occur in larger numbers in the lower whorls and are fewer in the upper ones. There are six stamens and numerous free carpels.

Female gametophyte : There is a hypodermal archesporial cell (Fig. 1) which functions directly as the mother cell without cutting off a wall cell. After the first reduction division is completed; it divides into two cells of which the upper degenerates early (Fig. 2) and the lower divides twice and produces a four-nucleate embryo sac (Figs. 3 and 4). Two nuclei are at the chalazal end and two are at the micropylar end. The former do not divide further, and the micropylar nuclei divide but once producing four nuclei. The mature embryo sac is thus six-nucleate (Fig. 5). There is the usual egg-apparatus; one of the group of the four micropylar nuclei functions as the upper polar nucleus; and of the two lower, one is the lower polar nucleus and the other represents the single antipodal nucleus. This is the smallest nucleus of all the nuclei in the embryo sac and soon degenerates. The difference in the size of this nucleus as compared with the others can be seen even at the four-nucleate stage. The upper polar descends down to meet the lower polar in the middle of the embryo sac (Fig. 6).

Male gametophyte : A single row of hypodermal cells in each anther lobe, as is usually described for other plants, is not distinguishable. A group of sporogenous cells differentiates in each lobe and the outer cells differentiate into a tapetum, which gives rise to a true periplasmodium. The microspore mother cells undergo two successive divisions to form isobilaterally arranged tetrads. The microspore nucleus (Fig. 7) divides producing a large tube and a smaller generative nucleus (Fig. 8). The latter again divides (Fig. 9) producing two spherical male nuclei (Fig. 10), which later become spindle shaped (Fig. 11). The mature pollen grain is thus tri-nucleate.

Embryo : The development of the embryo follows the usual course laid down for the monocots. The basal cell is very large and conspicuous. The endosperm is of the Helobiales type.

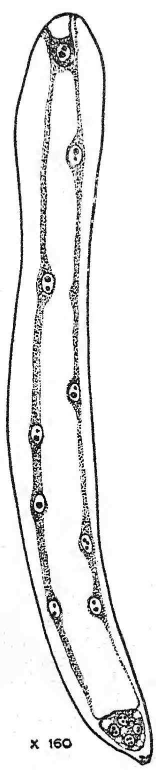
I am indebted to Dr. P. Maheshwari who suggested the problem and under whose directions the work was carried out.

BRIJ MOHAN JOHRI.
Department of Botany,
Agra College, Agra,
June 1, 1933.

The Development of the Endosperm in *Asphodelus tenuifolius* Cav.

IN a recent paper written by me in collaboration with Singh[1] there appears a statement that "The endosperm nucleus divides first and a free nuclear endosperm is formed". Further study made by me shows that the latter part of the statement needs to be modified.

The primary endosperm nucleus lies at the base of the embryo sac just above the antipodal cells which begin to disappear very soon after fertilisation. When it divides a wall is formed separating a small chalazal chamber from a large upper chamber. The nucleus in the chalazal chamber divides only once or twice, while the other nucleus in the upper chamber undergoes several free nuclear divisions. The figure shows an embryo sac in which the fertilised egg is still undivided though the endosperm is separated into two chambers of which the upper has several free nuclei and the lower has only four nuclei. This type of endosperm development is known as the Helobiales type and has already been reported in another sp. of *Asphodelus* by Stenar[2], who writes:—"Bei *Asphodelus fistulosus* ist die basale Zelle klein und kann leicht übersehen werden. In den wenigen Präparaten mit Endospermstadien, die mir zur Verfügung stehen, enthalt die untere Kammer vier Kerne. In dem ältesten beobachteten Stadium waren diese mehrfach grösser als die Kerne im zentralen Endosperm."



x 160

It is due to the small size of the chalazal chamber (as noted by Stenar also) and the lack of median sections that it was overlooked in my earlier preparations.

P. MAHESHWARI.
Botany Department,
Agra College, Agra,
June 12, 1933.

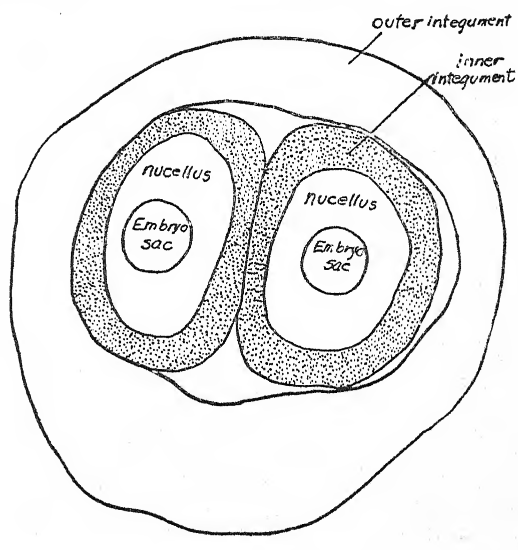
[1] Maheshwari, P., and U. B. Singh. "Development of the Female Gametophyte of *Asphodelus tenuifolius*." *Jour. Ind. Bot. Soc.*, **9**, 31, 1930.

[2] Stenar, Helge. "Zur Embryologi der Asphodeline-Gruppe." *Svensk. Bot. Tidskr.*, **22**, 145, 1928.

A Note on the Life History of *Hydrilla verticillata* Presl.

THIS note presents briefly the results of a detailed study of the flower and seed development of this plant, with special reference to the deviations from the normal course of development found in angiosperms.

Male flower: During the development of the microspores the tapetum forms a periplasmodium. The tetrads are isobilateral. The pollen is tri-nucleate at the time of shedding, consisting of a vegetative nucleus and two lenticular male cells. There is no fibrous layer in the anther, which is



evidently in adaptation with the aquatic habitat of the plant.

Female flower: The ovules appear as protuberances from the inner surface of the ovarian cavity and the archesporial cells are usually distinguishable at a surprisingly early stage. There are 1-3 sporogenous cells in each nucellus, but only one goes through

the reduction divisions, producing a linear or T-shaped tetrad of four megaspores of which the lowest functions. Its nucleus divides to give rise to the eight nuclei of the embryo sac which is of the usual organisation. The antipodal cells are ephemeral.

Paired ovules, borne on a single funiculus, were met with occasionally. The two nucelli had each an inner integument of their own, but a common outer integument. This is shown clearly in the figure which is drawn from a section passing transversely through the nucelli. Both the gametophytes were developing simultaneously and there is, thus, a possibilty of the occurrence of "false polyembryony".

Endosperm and embryo: The endosperm formation is of the Helobiales type. The lower cell enlarges considerably and remains undivided so that it can be seen even up to the formation of the cotyledon. The embryo is of the usual monocotyledonous type with a large basal cell. The full paper will soon be published elsewhere.

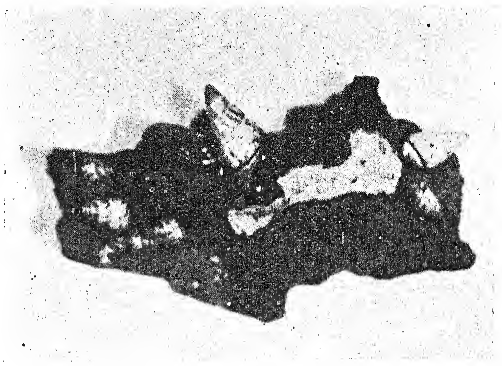
P. MAHESHWARI.

Botany Department,
Agra College, Agra,
June 12, 1933.

An Aestivating Gastropod from Mysore.

THOUGH it is a well-known fact that several gastropods protect themselves readily from the seasonal droughts, very little of it was known in the Indian forms until 1925 when Hora[1] reported on the æstivating habit of *Succinea arboricola* (Rao) from the Western Ghats. Later Hora and H. S. Rao[2,3] have extended our knowledge of this phenomenon to several other Indian gastropods.

When in last April, I had been out collecting fishes from Bethmangala tank, six miles from Kolar Gold Fields, I observed a few small gastropods æstivating in the crevices of the trunk and branches of Pongamia. They were tenaciously sticking to the bark of the trees. Most of them were young ones. I collected a few of them with the bark and sent some to Dr. Hora of Calcutta, for identification. The mollusc has been identified as *Rachisellus punctatus* (Anton) and so far as I can find from the literature available on the subject, its æstivating and tree climbing habits have not been recorded. A few of them were revived to activity in the laboratory by bringing them in contact with a small quantity of water. The epiphragm is thin and membranous and covers the shell completely. It becomes soft in contact with water. The animal moves actively on moist surface, but on recurrence of dry condition it withdraws itself into the shell and secretes another epiphragm within about fifteen minutes. When they are detached from the bark they generally fail to secrete the epiphragm and finally desiccate in a few hours. But in very few cases, however, a thin epiphragm is secreted inside the shell, which protects the animal from drought.



A piece of wood showing a number of æstivating *Rachisellus punctatus*. (*Natural size.*)

B. S. BHIMACHAR.

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Bangalore.

[1] Hora, S. L. *Rec. Ind. Mus.*, **27**, 1925.
[2] Hora, S. L. and Rao, H. S. *Rec. Ind. Mus.*, **99**, 1927.
[3] Hora, S. L. *Rec. Ind. Mus.*, **30**, 1928.

Aerial Respiration in *Pseudapocryptes lanceolatus* (Bl. & Schn.)

WITH reference to Dr. B. K. Das's account of a 'hitherto unknown' mode of ærial respiration in *Pseudapocryptes lanceolatus* (*Cur. Sci.*, **1**, 389, 1933), the following passage from Day [*Journ. Linn. Soc.* (Zool.) XIII, p. 202, 1877] is of special significance:

"In 1871, at Calcutta, I procured some living specimens of eels (*Ophichthys boro*). The gills of this fish are contained in large cavities, one on either side of the head, those on one side being divided from those of the other by an impervious septum. On watching its movements, it was seen to distend this receptacle with air taken in at the mouth, or, if in water, to live equally well by passing this fluid through the gill-cavity. On holding its small gill-opening firmly closed, it took in air by its mouth in distinct gasps: if its mouth were (*sic*) closed, it struggled until it was released, as, of course, without its use it could

not respire. On exposing the gills by cutting away the gill-membranes, and then placing it in water, it could be seen to slowly move its branchiæ, even when in such a situation that it could not obtain atmospheric air direct. It appeared to be able to employ for respiration air dissolved in water or air inspired directly from the atmosphere."

Attention may here be directed to a recent paper by Elfriede Schöttle entitled "Morphologie und Physiologie der Atmung bei wasser-, schlamm-und landlebenden Gobiiformes" (*Zeitschrift Wissen. Zoologie*, **142**, 1, 1932). A detailed account of the bionomics of almost all the well-known estuarine Gobioid fishes of India is contained in this article. *Pseudapocryptes lanceolatus* is also dealt with.

SUNDER LAL HORA.
Zoological Survey of India,
Indian Museum, Calcutta,
June 24, 1933.

Light Source in Hyperfine Structure Work.

IN experimental investigations on hyperfine structure it often becomes necessary to use a source which has the effect of showing the weak satellites relatively enhanced. For instance, in the case of Zn which has the following isotopes 64, 66, 68, 67 and 70, the order being that of decreasing relative abundance, the satellites corresponding to isotope 67 whose abundance is of the order of 5% (certainly not more than 10%) would be relatively faint. With the object of enhancing these satellites the source described in *Current Science*, Vol. I, p. 264, was devised. Essentially it consists in passing a stream of Zn vapour through a cooled-cathode mercury arc of length 30 cm. with a tungsten anode, observation being made axially. With such a source selective absorption has the effect of enhancing the weak satellites. Hence the intensities of the satellites corresponding to isotope 67 in the hyperfine structure patterns of the Zn I lines $4\,^3P_{0,1,2}$–$5\,^3S_1$, cannot be even in approximate agreement with the relative abundance of this isotope. The enhancement of weak satellites is of great utility when the objective is only the measurement of wavelength separations. It is hardly necessary to say that the second stage of self-reversal when a line becomes double should not be reached. In the case of the apparatus under consideration it is easy not to reach this stage by so regulating the stream of Zn vapour that the main component in each case never shows a doubling. It may be mentioned that in such an apparatus a satellite corresponding to an isotope whose relative abundance is small may approach or even outstrip in intensity a satellite of an isotope present in much larger relative abundance.*

When the reasoning centres round the relative intensities of the hyperfine structure components, self-absorption must be avoided. Especially is this so when, as in the case of Cs, resonance lines are under examination. One way of minimising self-reversal was described by Venkatesachar and Sibaiya in *Current Science*, Vol. I, p. 303. The method consisted in introducing a small quantity of caesium chloride into a vertical mercury arc with a tungsten anode. When the metal Cs was introduced into the arc, the two components of the resonance line were nearly equal in intensity, whereas when Cs was replaced by CsCl the components grew sharper and the intensity difference became distinctly marked. If nuclear spin is calculated from intensity considerations self-reversal has the effect of increasing the calculated spin. Minimising self-reversal by the above method, the nuclear spin of caesium has been found to be 5/2.

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July, 1933.

Aplanospore-formation in *Vaucheria uncinata* Kutz.

DURING our investigations of the Punjab Fresh-water Algæ, we came across a sheet of *Vaucheria uncinata* Kutz., in a pond called Mastiwal near Bodal in the Hoshiarpur District. Usually this species is found

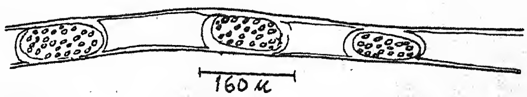


Fig. 1.

free floating in ponds and slowly flowing fresh-water streams but in this particular case a sheet of the alga was found partly

* Lau and Reichenheim. *Naturwiss*, **20**, 49, 1932.
Wood. *Phil. Mag.*, **8**, 205, 1929.
Metcalfe and Venkatesachar. *Proc. Roy. Soc.*, *A*, **105**, 520, 1924.
Venkatesachar. *Zs. f. Physik*, **75**, 676, 1932.

submerged in a drying puddle and partly exposed to dry air. Specimens were separately taken from both the parts and examined. It was found that filaments from the

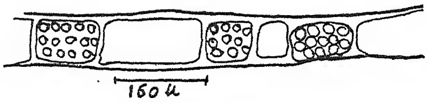


Fig. 2.

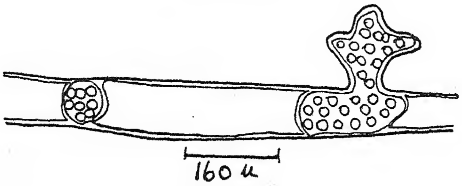


Fig. 3.

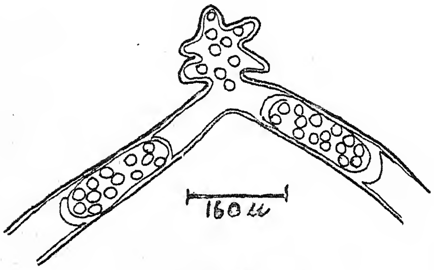


Fig. 4.

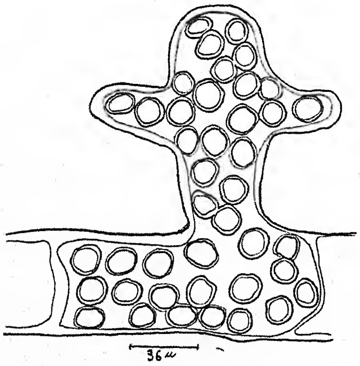


Fig. 5.

submerged parts were laden with oospores and antheridia, while in the exposed portion aplanospore-formation was dominant almost to the exclusion of the normal sexual process and replacing it in many cases. Extensive septum-formation takes place in the filaments so that they are cut off into coenocytes varying from 90 to 200μ in length (Figs. 1 and 2). These coenocytes later on become aplanosporangia, each containing from 8 to numerous rounded aplanospores with thick walls. The aplanospores average about 18μ in diameter and have a wall about 3μ thick. In many cases side branches which ordinarily bear oogonia laterally and an antheridium apically become filled with aplanospores (Figs. 3–5). One great peculiarity is the

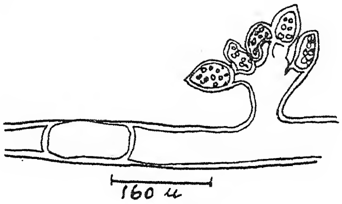


Fig. 6.

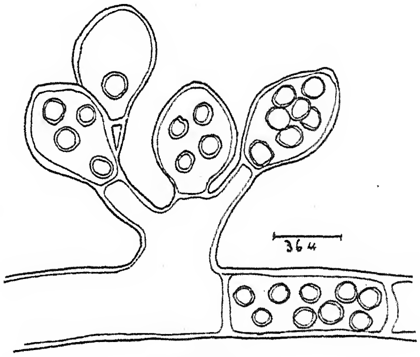


Fig. 7.

presence of aplanospores even in oogonium-like-structures, (Figs. 6 and 7) and in such cases it was seen that no antheridium terminates the bunch of these structures, so here we apparently see a case of replacement of sexual reproduction by a purely asexual mode of reproduction. In this case drought and unfavourable physiological conditions appear to be the cause of the change.

S. L. GHOSE.
M. S. RANDHAWA.

Government College,
Lahore,
July 1, 1933.

Geology.

LET History tell of mediæval strife,
Of Roman Cæsars, Grecian art and life,
Of Egypt's Pharaohs, Babylonian kings,
And all the passing pomp of human things;
Thy still more potent sight, new-risen Muse,
Sees further back, and where Man's records fuse
Into dark obscurity, thy tongue
Takes up the tale. To aeons yet unsung
Translated are our musing minds enthrilled,
To wait in awed delight and watch God build
The universe; back to each mighty stage,
Written in stone, page by rocky page;
Back to the dim and vapoury birth of spheres,
When chaos ceased, and heavenly charioteers
Began their fiery circling course to run
In silence round the blazing parent Sun;
Back to the wat'ry growth of boiling seas,
From which emerged by unperceived degrees
Majestic continents, beside whose plains
Mountains slowly piled their folded chains,
While subtle rain and frost and wintry gales
Began the endless fretwork of the vales;
Back to the dawn of Life, whose quickening breath
Rescued Nature from the silent death
Of involition, irresponsiveness;
When lowly plants and creatures numberless
Began that ordered chain, whose latest link
Was forged when Man stood trembling on Life's brink,
And ope'd his wondering eyes, for weal or woe,
To all the pageant of this earthly show.
What dazzling binding drapes so perfectly
The volumes of thy lithic library!
'Tis not to wonder that there are who fail
To turn the page and read the endless tale:
Of cliffs that nameless oceans once assailed:
Of beaches o'er which sibilantly wailed
The tides of seas whose floor is now a chain
Of snow-capped peaks; of streams which o'er the plain
Once wound their fertile way toward the strand;
Of yellow deserts whose unwater'd sand
Whirled aloft, like some Titanic hone
Whipp'd its polished mark on rock and stone;
Of lava floods that set the sky ablaze;
Of stormy floods; of sunny summer days;
Of raining skies which left their weeping mark
On smooth and sandy strands: of glaciers stark,
Glimmering white 'neath bygone moons; of trees
And fruits and flowers; of birds upon the breeze;
Of marshy bogs with tall unwieldy weeds;
Of smiling eye-like lakes eyelashed with reeds:
Of shifting coasts begirt with crumbling screes;
Of sinking continents or shallowing seas.
Records of every force and every strain
That folded, twisted, rent and tore in twain
Earth's meagre envelope that scarce divides
Her breathing millions from her molten tides—
These are thy deathless themes, which, without end,
From infinite to infinite extend.
Clio's sister fair, to thee belong
A newer minstrelsy, an older song,
That never ends and never has begun—
The Earth—our Mother and our grave in one!

E. H. P.

Cyst Formation in Plant Galls.

By M. S. Mani, *Entomology Section, Zoological Survey of India, Calcutta.*

HOW the irritation of the developing gall-maker gives rise to repeated cell-division, over-growth and consequent formation of galls, is but little understood. At one time it was held that the injury caused by the puncture in oviposition and in feeding gave rise to increased flow of sap and consequent increased cell-division and gall-formation. Such secondary changes alone do not give rise to gall-formation. While, in this connection, investigating the response of the vegetable tissues to the stimulus from the gall-maker, it was observed by the author that the morphological changes were preceded by complicated physiological ones. These latter are not passive but active changes brought about by the enzymatic secretions from the gall-maker. Where complete resistance and actual prevention of the irritation was not possible, adaptative changes occurred in the vegetable cells. Thus, in the case of the cynipid gall on *Quercus* sp., it is known that the cynip maggot produces a secretion containing two important enzymes, invertase and diastase. These act on the cells and dissolve them, which are then sucked up by the cynip larva. The tannin produced by the vegetable cells precipitates these two cell-dissolving enzymes, thus rendering them inactive. The tannin thereby acts as a barrier to the cell-dissolving activity of the cynip. It is itself, however, hydrolysed to gallic acid by tannase, another enzyme secreted by the cynip. This gallic acid changes to pyrogallol which is oxidised to purpurogallin by other oxidising enzymes, so that in the end tannin disappears totally in the place attacked by the cynip. This results in the dissolution by invertase and diastase of the vegetable cells. Such a series of complicated changes are accompanied by increased physiological activity of the vegetable tissue as is evidenced by the increased protoplasmic streaming and increased rate of respiration. The increased physiological activity brings about rapid mitosis and new cells are thereby formed, the rate of new cell-formation exceeding very much that of cell-destruction and hence the part grows.

Again in certain cases of parasitic fungus it is known that just in front of the advancing parasitic hyphæ the host cells are rapidly and thickly suberised so as to place a kind of barrier in the way of the attacking foe. This alone, however, does not constitute immunity or even resistance to diseases in plants, but an active, resistive, though inefficient effort on the part of the plant is clearly demonstrated. A somewhat similar adaptation in certain entomocecidia also has been observed by the author. The enzymes occurring in the secretion of the Itonid larva are found to give rise to ligninisation or suberisation of cell-walls. The Itonid larva by secreting enzymatic fluids dissolves and absorbs plant cells and thus bores a tunnel in the flesh of the gall. The cells surrounding this tunnel become thick-walled, heavily suberised or ligninised as the case may be. Such suberized or ligninised cells are not dissolved by the secretions of the larva. Gradually this process spreads to several layers of cells, beyond the ones immediately lining the cavity of the tunnel, so that in due time the Itonid larva is completely enclosed in a hard, brittle, fistular structure, which is either completely closed or opens to the outside on the surface of the gall. The Itonid which by this time reaches, in the majority of such cases, the pupal stage, thus appears as if it were encysted in the flesh of the gall. In many cases of parasitism by worms, as in *Tinea solium* in the flesh of pig, it is generally known that due to some kind of irritation of the presence of the foreign body the muscular tissue of the host secretes a shell or cyst in which the worm is completely enclosed. By analogy, the hard fistular structure formed round the Itonid in the flesh of galls described above may also be called *cysts*.

The cyst, being made up of dead and thickened cells, appears to act as a kind of mechanical, perhaps also physiological, barrier to the irritant activity of the Itonid, so that after suberisation or ligninisation (cyst formation), active cell proliferation (the abnormally rapid cell formation by mitosis) is nearly brought to a standstill and the gall practically ceases to grow. Cyst formation begins at different periods in different galls. When it is complete before the Itonid pupates, the growth of the gall is arrested and the gall is relatively

small. This however does not appear to be the case always and then the size of the gall is not in any way affected by the presence of cysts.

Cysts are not formed in every gall. In fact, galls may be divided into two distinct classes as *cystiferous* or cyst-bearing and *acystiferous* or non-cyst-bearing. Examples of the former class are the shoot galls of *Cephalandra indica* Nees, *Pongamia glabra* Vent., *Melothria heterophylla* Cogn. and leaf galls of *Odina wodier* Roxb. (all by undescribed Cecidomyidæ) and also the leaf galls of *Mangifera indica* Lin. by *Oligotrophus mangiferæ* Felt. Examples of the latter class are shoot galls of *Momordica charantia* Lin. by *Lasioptera falcata* Felt. and the fruit gall of *Pongamia glabra* Vent. by *Asphondylia pongamiæ* Felt. The cysts of the shoot gall of *Melothria* and *Cephalanda* are longitudinal, sinuous, cylindrical tubes, made up of suberised cells. The cyst in the shoot gall of *Pongamia* is a short, stout, hard tube of ligninised cells. That of the leaf gall of *Odina* is a hard L-shaped, cylindrical structure opening on the surface of the gall and made up of ligninised cells.

Though this extremely interesting structure appears to have been observed by various previous workers, its true nature is not yet understood. The correlation between this curious structure and the growth, shape, size, etc., of the galls bearing them is under detailed investigation and the author hopes to report more about this on some future occasion.

Notes on Some Hydro-Electric Schemes in India.

By Dr. Ram Prasad.

IN these notes an attempt is made to point out some of the important features of Hydro-Electric development in India giving some details of a few of the systems. The development of power in the Mysore State is dealt with first, to show what can be accomplished in public service utilities through Government agency. Next, the two major Hydro-Electric schemes are described which were recently put into service, one in Northern India and the other in Southern India by the respective local Governments and are intended to help forward the industrial and incidentally agricultural development of the provinces by providing a plentiful supply of moderately cheap power over a wide area.

The localities where Hydro-Electric Power is generated in India may be divided into four sections:

(1) The Northern and Sub-Himalayan section including the Ganges canal network.

(2) The West Coast section near the Ghats.

(3) The Southern part of Deccan Plateau.

(4) The Southern section from the Nilgiri Hills downwards.

Under section (1) may be included:

(*a*) The Uhl River Hydro-Electric Project of the Punjab Government near the Himalayan foothills which will serve the Punjab. This scheme was started in 1926 and the 1st stage of 48,000 E.H.P. was put into service in March 1933.

(*b*) The Ganges Canal and Ramaganga Scheme of the Government of the United Provinces of Agra and Oudh which utilize the canal falls of the famous Ganges river canal systems. This scheme of 3,500 E.H.P. was put into service in 1931 and is intended to serve the western and middle section of U. P.

Under section (2) we may include the Hydro-Electric Power systems organized by Messrs. Tata & Sons of Bombay. This big network obtains its power from three generating stations which derive their water from artificial lakes constructed on the Western Ghats and supply the power requirements of Bombay, Poona and the surrounding territory including the G.I.P. and B.B. & C.I. Railways, through numerous sub-stations and transmission lines. The initial stages of the scheme were put into service before 1914 and the system has been gradually extended to its present capacity of about 250,000 E.H.P.

Under section (3) comes the Cauvery Power Scheme in the Mysore State which is the oldest Hydro-Electric system in India and derives its power from the waterfalls of the Cauvery near Sivasamudram where the Mysore plateau descends to the plains. This scheme was started in 1902 with a capacity of 5,000 E.H.P. mainly to supply

power to the Kolar gold mines and has been gradually extended to meet the increasing demand of the mines and other growing industries in the State and has a capacity of 46,000 E.H.P. at present.

Under Section (4) comes the Pykara Hydro-Electric Project of the Madras Government on the slopes of the beautiful Nilgiri Hills. The scheme was begun in 1926 and the first stage of 22,000 E.H.P. was put into service in April 1933. This is intended to serve the industrial and agricultural districts of southern Madras Presidency and to link up with other projects that may be undertaken in Madras later on.

Besides these major Hydro-Electric schemes there are various small systems scattered in the Bombay Presidency, Tea Estates in south-west Madras, and on the Himalayan borders of Assam and Bengal. There are many undeveloped areas with possibilities of major schemes which in years to come will provide large blocks of power for the industrial and rural requirements of India.

The following statement gives some useful data regarding the major schemes now in service:—

No.	Name of the Scheme	Province	Height above Sea Level of Forebay	Head in feet used	Station Capacity	Quantity of Water required	Main Transmission Voltage	Other Details
1	Cauvery Power Scheme (C.P.S.)	Mysore State	2,000 ft.	410 ft.	46,000 E.H.P.	1,200 cusecs	76,000 & 37,000 volts	Francis Reaction Turbines
2	Tata Power Co. Group	Bombay Presidency	About 2,500 ft.	About 1,000 ft.	About 250,000 E.H.P.	3 stations each about 600 to 800 cusecs	110,000 volts	Impulse Wheels
3	Ganges Canal & Ramaganga Schemes	United Provinces	About 500 ft.	6 to 12 ft.	3,500 E.H.P. (I stage)	4,000 to 8,000 cusecs	37,000 volts	Francis Reaction Turbines (Vertical)
4	Uhl River or Mandi Hydro-Electric Project	The Punjab	6,000 ft.	1,800 ft.	48,000 E.H.P. (I stage)	150 cusecs	132,000 & 66,000 volts	Impulse Wheels
5	Pykara Hydro-Electric Scheme	Madras Presidency	7,000 ft.	3,080 ft.	22,000 E.H.P. (I stage)	60 cusecs	66,000 volts at present (later on 110,000 volts)	Impulse Wheels

THE CAUVERY POWER SCHEME.

The Cauvery Power Scheme (C.P.S.) was started by the Government of Mysore in 1902 primarily to supply power to the gold mines at Kolar, at a distance of about 90 miles, with a generating capacity of about 5,000 E.H.P. and power was transmitted at 35,000 volts. During the last 30 years, as the demand for Kolar increased and new demands came up in Bangalore and Mysore, the capacity of the Generating station, Transmission lines, and the sub-stations was gradually increased, so that to-day the capacity of Sivasamudram Station is 46,000 E.H.P. and the voltage of power transmission is 76,000 volts.

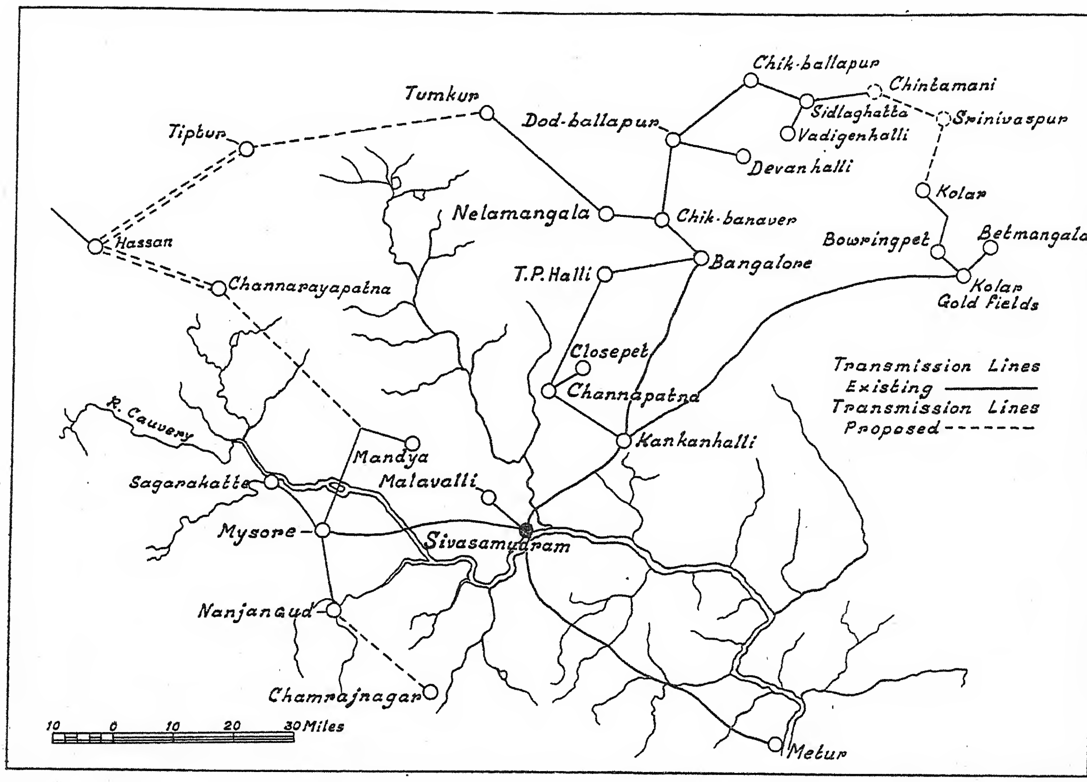
Being a medium head development (410 ft.) the original turbines of the Impulse type have been gradually replaced by the latest type of Reaction Turbines (Francis) equipped with suitable oil pressure governors. As the Cauvery river is laden with fine silt and sand several experiments had to be carried out in co-operation with the turbine manufacturers to minimise the wear and tear of the runners and wickets and suitable designs were arrived at and adopted. The question of "Erosion" of the turbine runners due to the liberation of nascent oxygen from the water under partial vacuum has also been successfully tackled by electric welding, and a modified design has also been adopted using chrome nickel steel for the manufacture of the runners. Similarly based upon local experience the design of the transformers and switch-gear have been modified to suit the

requirements. Even this year, in order to increase the overall efficiency of the power station and also to increase the overload and stand-by capacity a new turbine and generator (8,000 E.H P.) are being installed and will replace three impulse wheel machines of a total 6,000 H.P capacity. The latest design of fabricated steel frame is being used for the generator and some improvements in the turbine design has also been effected. When this is completed the effective capacity will be given by:—

3 Generators of 8,000 E.H.P. each coupled to 9,000 B.H.P. reaction turbines and 7 generators of 4,000 E.H.P. each coupled to 5,600 B.H.P. reaction turbines. Power is generated at 2,200 volt, 3 phase 25 cycles and is stepped up to 76,000 volts by means of 5 Banks of Transformer of which 3 are of 10,000 KVA each, and 2 of 5,250 KVA each at 85% power factor.

Efficient and close regulation of the turbines by suitable governors and the voltage regulation of the generators by automatic voltage regulators enable easy handling of sudden peak loads (hoist load of mines) of nearly 3,000 H.P. without any appreciable change in the frequency or voltage at the receiving end.

From the Sivasamudram Power Station there are six main transmission lines of which two are for Kolar at 76,000 volts, and two carry the power at 76,000 volts to Kankanhalli, about half-way between Sivasamudram and Bangalore, where three Banks of Auto-Transformers step down the voltage to 37,000 volts for transmission to Bangalore over duplicate lines. Another two lines designed for 76,000 volts (now working at 35,000 volts) carry the power to Mysore where there is provision to link up the system with another power station that may be built at the Cauvery Reservoir about 10 miles from Mysore (Krishnaraja Sagara).



There are also two temporary lines at 37,000 volts now supplying power to Metur where the Madras Government are constructing a huge dam lower down across the Cauvery River for purposes of irrigation.

The following table may be interesting:—

Sub-Station	Distance from Gen. Stn.	Normal load as measured at Gen. Stn.	Type of Load
Kolar	95 miles	25,000 E.H.P.	Mining load including deep mine hoists, water pumps, air compressors, crushing and mechanical load and general lighting all over.
Bangalore	65 miles	13,000 E.H.P.	Textile mills, oil and flour mills, saw mills, minor industries, irrigation pumps, city water supply, and general lighting all over.
Mysore	35 miles	4,000 E.H.P.	Textile mills, rice mills, oil mills, saw mills, city water supply, minor industries, irrigation pumps and general lighting all over.
Metur (Temporary)	63 miles	2,400 E.H.P.	Concrete mixers, hoists, mortar mills, stone crushers, water pumps, water supply and general lighting all over.

There is a future demand for power in the western and north-western sections of the Mysore State where there are big tropical forests and moderately high mountains where coffee and tea plantations are coming up. Possibilities for the manufacture of pulp and paper out of bamboo or other suitable trees are very favourable and will require large blocks of power. If conditions permit the power lines may be extended to this area and also supply power to the Mysore Iron Works for driving their motors and if possible for smelting purposes. Later on if power demands justify it, another generating station of about 30,000 or 40,000 E.H.P. may be constructed at the north-western corner of the State by harnessing the Sharavati River near Jog Falls (910 ft.), one of the highest falls in the world.

By means of medium voltage (4,600 volts) and low voltage (2,300 volts) networks, nearly the whole of the southern and eastern part of the Mysore State has been electrified and power is being used for irrigation pumps and general lighting in nearly 25 small towns and 50 villages. The final supply to the consumers is at 220 volts by step-down transformers.

Before long this number will be increased many times and electricity will serve even the humblest villages in this area. This is very desirable as Mysore has no coalfields, oil-wells, or even a seaport to import fuel at low rates.

Continuity of service to the consumers is a very important feature which is maintained by means of double or quadruple circuit power lines, suitable sectionalizing stations, and automatic switching and protective equipment of the most up-to-date design. At the important sub-stations which derive power over long distance transmission lines such as Kolar and Bangalore suitable synchronous motors (condensers) have been installed for improving the power factor of the load and incidentally limiting the voltage fluctuations within reasonable limits. Distribution of energy is done through 2,300 volt, 3 phase 25 cycle power lines in towns and cities and through 4,600 volt, 3 phase 25 cycle power lines in rural areas.

The C. P. S. being a Government concern, power is supplied directly to the ultimate consumer so that the cost of retail power supply is kept low and in case of need, all the resources of the Electric Department are available for keeping up the service or effecting repairs, etc. The localities served by the Cauvery power are inhabited by communities in various stages of civilization and culture and it is remarkable how the so-called illiterate and apparently backward agriculturists and farmers have taken to electricity to replace manual and bullock power. The ancient and crude appliances are being replaced by up-to-date equipment and the earning capacity of the farmers has been appreciably increased. Small land-holders purchase electrically-driven pumps from the Government on easy hire purchase system and earn decent profits from their 5 or 10 acres of land on which are grown potatoes, onions, ordinary vegetables, flowers and sometimes fruits and sugarcane. Even domestic cooking by electricity is becoming popular in some towns, the cost of energy being ½ anna per unit for this purpose whereas it is 1 anna for general

rural power supply for 10 H.P. or less. At present the entire staff of the Cauvery Power scheme is manned by Indian engineers and workers who have had suitable technical training in India and abroad. The latest developments in the design of machinery and equipment are carefully studied by the technical staff and every opportunity is availed of to bring the power station and transmission line maintenance and operation up-to-date. Recently a 37,000 volts system was successfully linked with the major 76,000 volts network by means of star-connected auto-transformers equipped with delta-connected tertiary windings that eliminate the higher harmonics. Differential current relay protection for generators and transformers, balance current and reverse power relay protection for the transmission lines, cut off faulty apparatus or power lines from the other good sections, and help easy location of faults, quick repairs and effective service. The insulators for the transmission lines are installed after rigorous tests and the design of the lines aims at a high factor of safety at reasonable costs. Suitable bird guards, locally made, have effectively eliminated the troubles from birds on the power lines.

During recent years investigations were carried out to utilize the tall varieties of trees grown in the Mysore forests, for transmission line supports, and a special species (Balega) which is white-ant proof has been found satisfactory after tests. These poles are now being used after they are creosoted with creosote oil manufactured by the Mysore Iron Works.

The manufacture of porcelain insulators required by the Electric Department, has been undertaken by Government and the requirements are being supplied. In this connection the co-operation and help of the Indian Institute of Science with regard to the electrical and mechanical tests has been very valuable. Attempts are being made to fire the insulators in electric kilns.

For the distribution system, step-down transformers are being made by the department in their own laboratories successfully.

The C.P.S. has been progressive since its inception and has pioneered in many respects. There is field for expansion in the matter of electro-chemical industries and electrification of railroads.

THE UHL RIVER OR MANDI HYDRO-ELECTRIC SCHEME.

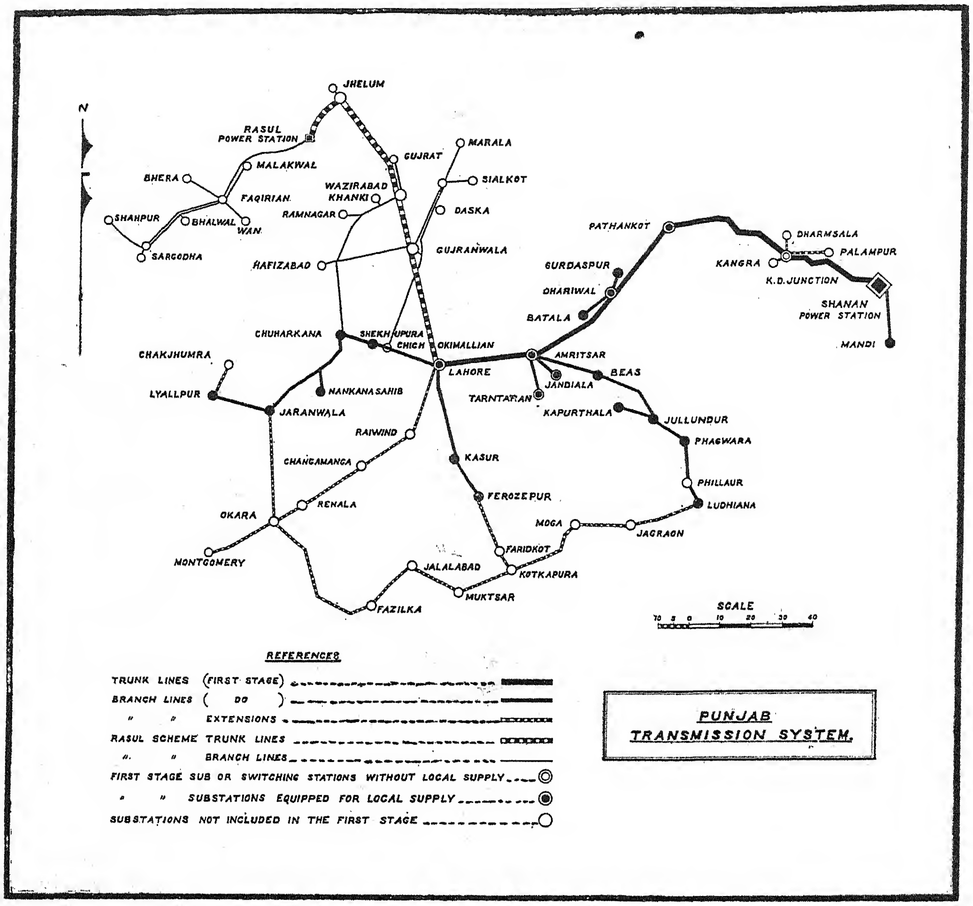
This power scheme put into service in March 1933 is located at Jogindernagar and derives its water power from the snowbound Uhl River, a tributary of the Beas in the Punjab, where, diverted for power, the Uhl River runs at an elevation of about 6,000 ft., and a tunnel about $2\frac{5}{8}$ miles long had to be driven through the hill to take out the water to the outer slope where a head of 1,800 ft. could be obtained. Further drops of 1,200 ft. and 750 ft. are available lower down and will be utilized later when required.

The project has been designed for 48,000 E.H.P. in the first stage of development based on the natural flow of the river, about 150 cusecs, not reinforced by storage. The ultimate capacity is expected to be about 96,000 E.H.P. when a reservoir for the storage of 2,000 million c.ft. of water is constructed. If the power stations at the two lower slopes are constructed their capacities will be 64,000 E.H.P. and 40,000 E.H.P. respectively. The combined ultimate output of the 3 power stations would then be 200,000 E.H.P. Compared with the three Tata Schemes near Bombay with an aggregate installed capacity of 250,000 E.H.P., which form the largest group of Hydro-Electric undertakings in India, the Uhl river scheme stands second in order of power output with an installed capacity in its first stage of 64,000 E.H.P. When developed to its final stage it will rank as one of the major schemes in the world.

In the power station are now installed 4 generators each of 16,000 E.H.P., 11,000 volts, 3 phase 50 cycles 428 R.P.M. driven by single jet pelton wheel turbines. The step-up transformer equipment comprises two banks of transformers each of 24,000 Kw. 11,000/132,000 volts and of the outdoor type. This is the first scheme in India to transmit energy at 132,000 volts, the highest hitherto attempted being that of the Tatas at 110,000 volts. Double circuit transmission lines at 132,000 volts are laid out from Jogindernager to Lahore—a distance of 173 miles—and branch lines are also laid out operating at 66,000 volts from Amritsar to Ludhiana (88 miles), Lahore to Lyallpur (89 miles) and to Ferozpur (50 miles).

In about 15 towns a complete system of local distribution is provided by which retail supply is given direct to the consumers similar to C.P.S. in Mysore. But in those localities where there are already licencees, power will be supplied in bulk to

the licencees, for distribution as in Lahore, Amritsar and Jullundher. A bulk supply to Kapurthala and other neighbouring States will probably be taken very soon.



The primary object of this scheme is stated to be to give effect to the desire that Government should help forward the industrial development of the province by providing a plentiful supply of cheap power over a wide area. The Punjab possesses no coal of commercial value and the cost of imported coal is about Rs. 25 per ton, more than half of which covers freight charges.

When the branch lines are extended to rural areas as in Mysore, it is hoped that power will be taken up by agriculturists for pumping water in non-irrigated tracts and also for the relief of water-logged areas and for farming operations. Supply is being offered for industrial purposes on a tariff which by its terms will continuously favour the consumer who uses electricity in increasing quantity.

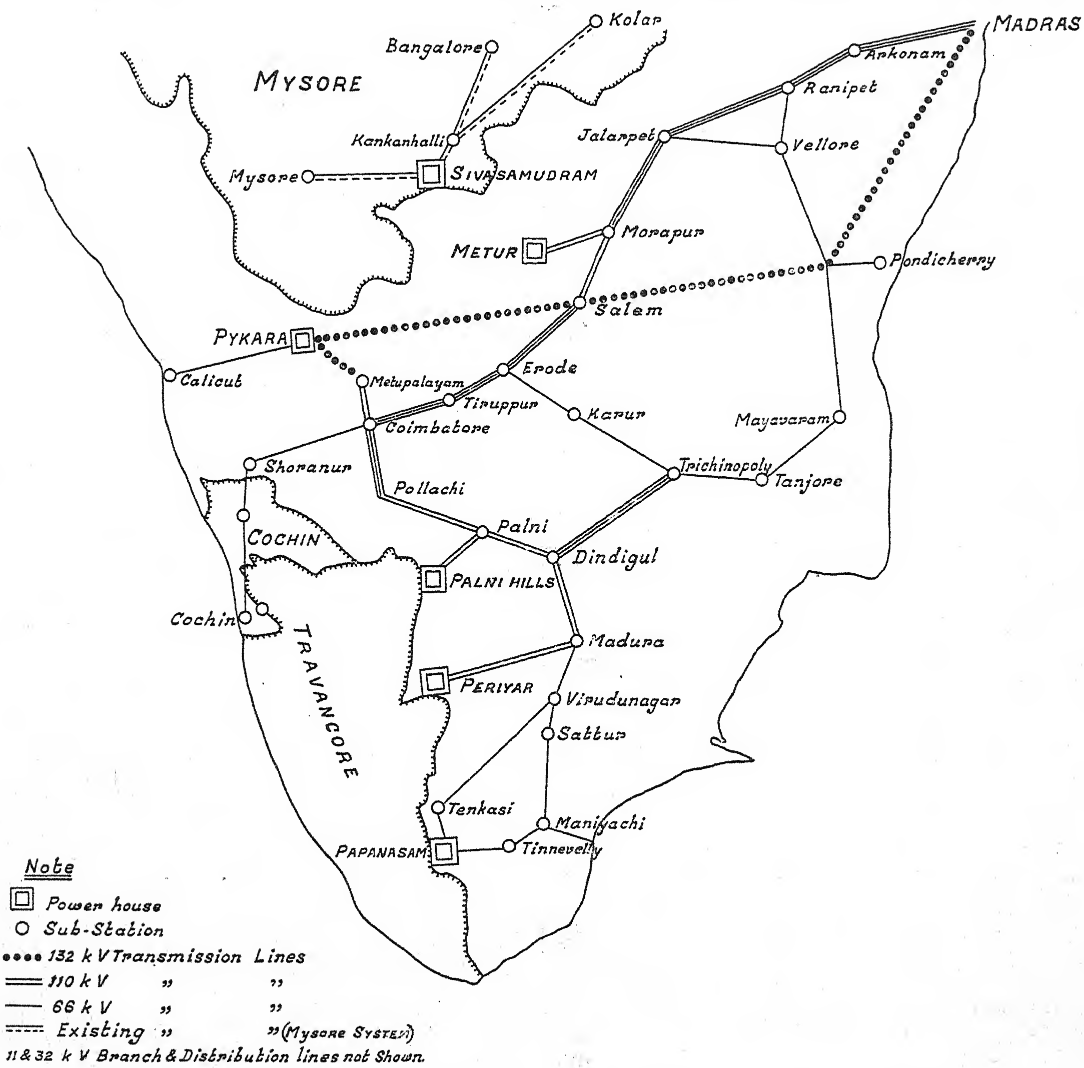
THE PYKARA HYDRO-ELECTRIC SCHEME, MADRAS.

The present scheme makes use of the waters of the Pykara River which drains the Nilgiri plateau at an altitude of about 7,000 ft. about 15 miles from Ootacamund. At the northern edge of the plateau the river drops to nearly half its altitude, within a short distance making up a total maximum head of about 4,000 ft. available for power. But at present only a head of about 3,080 ft. is utilized for power purposes. The catchment area of the river is about 38 sq. miles receiving an average rainfall of 80 to 100 inches. The amount of water flowing in the river in different parts of the year is variable, ranging from 20,000 cusecs in July to 15 cusecs in May. Hence the necessity of a storage reservoir to supply the average quantity of water required for power. If the full extent of the reservoir capacity be developed (3,000 million ft.), about 90,000 H.P. can be developed at the

Pykara station, and 30,000 H.P. from the tail water at a site a few miles below the main power house.

The first stage put into service in April 1933 utilizes a head of 3,080 ft. to develop a maximum of 22,000 E.H.P. using about 60 cusecs. The storage reservoir now constructed impounds about 84 million c.ft. It may be noted that the Pykara scheme is the highest head plant in the British Empire including North and South America and believed to be one of the 5 highest head plants operating anywhere in the world. The total length of the pipe line from the forebay to the generating station is about 10,000 ft. made up of sections of 27″, 24″ and 21″ pipes.

The generating plant consists of three units each consisting of 10,900 B.H.P. impulse turbines driving an alternator 7,810 KVA. at 11,000 volts, 50 cycles, 600 R.P.M. Provision has been made for the installation of 4 bigger units each of 17,000 H.P. For stepping up the voltage to 66,000 volts, at present there are 2 banks of transformers each 7,810 KVA. 11,000 volts′ 66,000 volts′ 110,000 volts. In the later stages when the power demand increases the voltage of transmission may be increased to 110,000 volts.



For the present the main centre of load is expected to be Coimbatore, about 50 miles from the power house and the transmission in voltage at present is 66,000 volts. All

the transformers, switch-gear and lightning arresters are of the outdoor type. The receiving station at Coimbatore is also of the outdoor type and contains 4 banks of transformers each of 3,000 KVA. 66,000 volts' 22,000 volts' 11,000 volts. A double circuit 66,000 volts transmission line leads to Tiruppur and Erode, which at present are operating at 22,000 volts. In addition to this there are sub-stations at Erode, Tiruppur, Pollachi, Palghat and Iyerpad; the last one for tea factories in the Annamalais. Erode is connected to Salem and Metur and Pykara to Ooty directly.

There are possibilities of power being taken to Cochin, Travancore, Madras and Trichinopoly. When Metur Power Station is linked with Pykara, a 110,000 volt line will supply power to Madras City also.

Diffusion of Diseases.

THE League of Nations Regional Health Conference which met at Cape Town in November last year discussed the extension of yellow fever beyond barriers heretofore effective, but rendered possible by the improved methods of travel by railway trains, aeroplanes and motor cars. Major-General J. D. Graham's report points out the danger of the extension of this disease from West Africa to East Africa and from there to the Asiatic countries, and emphasizes the need of adopting suitable measures to combat the possibilities of the introduction of this new scourge into India.

Almost every mechanical invention seems to contain the germs which endanger human life and we realize the risks only after the invention has been harnessed for the service of mankind. The steam engine which introduced the industrial revolution, possessed enormous potentialities for opening up the countries for economic and cultural development and few could suspect at the moment that railway service would become the means for the spread of diseases. Wherever man moves, he carries with him obviously, in spite of the greatest precautions, the vectors of disease and especially where services are introduced for carrying large masses of population occupying different hygienic levels, the danger of a rapid spread of infection, is real and acute. If railway trains are intended to promote wider human intercourse, to develop trade and commerce, to carry knowledge and civilization to remote parts of the country, they have been the effective means of equalizing the incidence of diseases also. In spite of the utmost precautionary measures, diseases escape the vigilance of custom house offices without paying the duties. Nature seems to mock at us in our efforts to secure only the good and eschew the bad and if the facilities of rapid transport confer a boon on us, we have to be prepared to accept the evils brought in its train. Medical research and the quarantine regulations may mitigate their severity but cannot avoid them.

Probably in the case of yellow fever we have in our power the means of effectively combating its extension. We know the breeding habits of the different species of mosquitoes and the researches of the Ross Institute have placed at our disposal the remedial measures for controlling or destroying the entire mosquito population. Malaria is now well under control and Medical Science should be engaged not only in restricting the spread of yellow fever but in totally wiping it out, for so long as it is permitted to exist even in remote and isolated tracts, its extension to wider areas is almost a certainty. Civil aviation which links up the large towns where sanitary arrangements are satisfactory, is not the real source of danger, but flights undertaken to establish records and those in the nature of sensational stunts constitute a real menace, especially when there is a forcible landing in inhospitable and disease-ridden country. In India, the introduction and rapid extension of bus traffic, which has undoubtedly opened up the country side, has become the means of disseminating diseases. The problems of cultural development and the promotion of commerce and trade are closely associated with those of the preservation of health and physical efficiency of man and Science cannot afford to relax its vigilance or view with detached interest the rapid extension of traffic in the country.

Proteins and Proteoclastic Enzymes.

THAT the properties of a protein are not a simple summation of those of its constituent amino acids is the theme of a course of three lectures on "The Chemistry of Proteins" delivered by Prof. Max Bergmann of Dresden, at University College Hospital, Medical School, London, in January last (*Nature*, **131**, 662, 698, 1933). The behaviour of the amino acids in proteins are influenced by the peptide linkages, and *vice versa*. Prof. Bergmann arrives at these conclusions from a study of the reactions of a few amino acids, whose zwitterionic character has been so modified as to simulate their condition in the peptide molecule. Thus, on acetylating an optically active amino acid, it easily suffers racemisation under the catalytic influence of acetic anhydride. As an intermediate enolisation $R\cdot CH(NH.OC.CH_3)\cdot COOH \rightarrow R\cdot C(NH\cdot OC\cdot CH_3) : C(OH)_2$ alone can explain the racemisation, this is possible only by the peptide linkage of the acetylated compound influencing the α-hydrogen. The corresponding chloroacetylated compound retains its optical activity under similar treatment. As other examples of the mutual influence of the peptide linkage and amino acid may be cited, *inter alia* (i) the *in vitro* experiments to show the conversion of an amino- to a keto- acid through dehydrogenation and *vice versa*, and (ii) the reactivity of arginine on acetylation and simultaneous dehydration; the triacetyl anhydroarginine thus obtained easily yields with sarcosine, for example, creatine and a derivative of ornithine, while in presence of cold water, the compound readily hydrolyses to acetyl derivatives of ornithine and urea.

To a better understanding of the mutual influence referred to above, a number of peptides have been prepared with the use of the acid chloride of benzyl carbonic acid, obtained by treating benzyl alcohol with phosgene. The *modus operandi* is as follows: acid chloride of benzyl alcohol + amino acid $\rightarrow$ benzyl carbonato amino acid (A); A $\rightarrow$ corresponding acid chloride or azide (B); B + another amino acid $\rightarrow$ benzyl carbonato peptide (C); C $\xrightarrow[\text{Palladium Black}]{\text{hydrogenated}}$ toluene, carbon dioxide and the peptide, the final step of the process avoiding all risks of peptide scission. This method has not only made possible the preparation of even those peptides whose synthesis has been a failure hitherto, but all the peptides are obtained in their optically active condition, which is a very distinct feature of the method. The peptides thus prepared have been subjected to the action of enzymes, which, because of their specific nature, have been employed to decide the mode of linkages therein. The synthetic peptides under the several influence of dipeptidase, amino-polypeptidase, and trypsin, behave in the anticipated manner. Not all the dipeptides are attacked by dipeptidases, nor are they, in all events, the specific substrates for the latter enzymes. As illustrations of these findings may be mentioned, notably the resistance of asparagyl-tyrosine to all intestinal proteolytic enzymes but the ready hydrolysis by peptidase of the closely allied compound glutamyl-tyrosine; the hydrolysis of tyrosyl-tyrosine not only by dipeptidase but also by carboxy-polypeptidase and the inactivity of dipeptidase towards glycyl- and alanyl prolines and their hydrolysis by amino-polypeptidase. They show at once the extent to which the amino acid residue influences the peptide linkage to enzyme attack and the need to revise enzyme nomenclature. Again, an unsaturated peptide like glycylde-hydrophenylalanine is unattacked by dipeptidase despite the presence of a normal peptide linkage in the compound. The corresponding dehydro-dipeptidase, however, has been shown to exist in the kidney: through the action of this enzyme a possible mechanism of a part of protein metabolism has been suggested.

The question now arises whether linkages other than the normal peptide ones occur in the protein molecule. Though proteolysis generally results in a release of equivalent amino and carboxyl groups pointing to the existence of normal peptide linkages, illustrations of other types of linkages are not wanting. On comparing the successive actions of trypsin and intestinal peptidase on gelatin with the enzymic hydrolysis of proline peptides, it results that a large portion of proline in gelatin is combined through its imino group. Difficulties inherent to heterogeneous systems as prevailing in the enzymic hydrolysis of natural proteins, have largely impeded the proper understanding of the mode of action of proteinases. An ingenious method, no doubt, has been developed to establish that the course of enzymic digestion of gelatin spread in a thin film of uniform thickness, follows the Schütz's rule. But methods of far wider application have yet to be evolved for a fuller and a more perfect understanding of the structure of proteins and the action of proteoclastic enzymes.

M. SRINIVASAN.

The Indian Mathematical Society.

THE Indian Mathematical Society has completed the first twenty-five years of its existence and the Silver Jubilee Conference was held in Bombay in December last.

In order to enlarge its activities and serve the needs of students and teachers of mathematics, it has been decided to issue two quarterlies in place of the "Journal of the Indian Mathematical Society" published hitherto. In 1933, the Journal will appear as the Jubilee Memorial Volume containing an account of the Eighth Conference held at Bombay and the Jubilee Celebration. The second quarterly is issued under the name of the "Mathematics Student" and we have received Vol. I, No. 1 of the new Journal. In a foreword, it is stated that this will seek to stimulate interest, encourage wide reading and a critical appreciation of results. It will be the official organ of the Society for all announcements and will attempt to keep its readers in touch with the mathematical world of India and abroad. It will devote itself to raise the standard of mathematical instruction in the country and provide a medium for exchange of ideas.

The first number of the new "Mathematics Student" contains an article on "Some Glimpses of Ancient Hindu Mathematics" by A. A. Krishnaswamy Ayyangar and another on "On Conics having a common Self-Conjugate Triangle" by K. Satyanarayana. There are notes and discussions as also questions and solutions that formed a regular feature of the Journal. We wish the Society a long and prosperous career of increasing usefulness.

The Calcutta School of Tropical Medicine.

THE annual report (1932) of the above institution and the Carmichael Hospital for Tropical Diseases which has just been issued is a highly valuable document representing the progress of a large section of medical research in India. The report of the Director (Lt.-Col. H. W. Acton) reviews, in broad outline, the expansions in the different departments, new researches undertaken and the more important results obtained. Among the expansions, mention should be made of the opening of the All-India Institute of Hygiene and Public Health under the direction of Lt.-Col. A. D. Stewart. It is also refreshing to note that although the year was one of all-round financial distress, the different researches were not cramped for want of funds. In addition to the India Government and the Government of Bengal, the Indian Research Fund Association, the Indian Tea Association, the Indian Jute Mills Association, the Calcutta Corporation and other institutions, as also a few private individuals, contributed generously and helped the School to tide over a difficult period.

The report of the Director is followed by more detailed contributions from the heads of the departments. The Superintendent of the Carmichael Hospital records some peculiar clinical cases that came to his notice. The Professor of Tropical Medicine (Dr. S. P. Bhattacharjee) and his staff paid special attention to problems relating to tropical splenomegaly and cirrhosis of the liver in infants. The department of Bacteriology and Pathology under Lt.-Col. H. W. Acton devoted considerable attention to the origin and nature of phagedenic ulcers (Naga Sore), diagnosis and treatment of human carriers of dysentery, correlation of bacteriological examination of stools with their clinical significance, Vitamin B content of food in relation to the incidence of epidemic dropsy and a number of skin diseases. A cheap and efficient nutrient medium using the papain digest of the green mung dal (*Phaseolus mungo*) in place of peptone water and meat broth has been developed. The work of the department of Protozoology under Lt.-Col. R. Knowles included routine work relating to the examination of pathological products as also to the extension of the work on (*a*) transmission of the malaria in different areas, and (*b*) the human and the monkey malaria by numerative and cultural methods. Atebrin, the newly introduced synthetic preparation, has been tried on all the three species of human malaria with highly satisfactory results.

In the department of Serology and Immunology a number of laboratory tests for clinical purposes were standardised under the direction of Lt.-Col. R. B. Lloyd.

The report of the Professor of Pharmacology (Lt.-Col. R. N. Chopra) presents several interesting features. The work on snake venoms has shown that there is no justification for their use as either cardiac stimulants or for the treatment of epilepsy, insanity, asthma and such like diseases for which they are recommended in Indian Medicine. Studies on musk have shown that its fame as a cardiac tonic is not fully justified and that the therapeutic uses of that drug as cardiac and respiratory stimulant have generally been over-rated. An investigation into the absorption and therapeutic effects of Makaradhwaja have shown that its tonic properties correspond to those of minute quantities of mercuric chloride: it would appear therefore that it is an insoluble preparation of mercuric sulphide which is acted on by the gastro-intestinal juices so that minute quantities of mercury pass into the ionic condition to produce the characteristic tonic effects. These observations do not, however, fully dispose of the fact that the use of even highly purified mercuric sulphide in place of Makaradhwaja often leads to mercurial poisoning. Work on various indigenous drugs as also chemotherapeutic studies and biological assays on a number of substances sent from various parts of the country have been reported.

The department of Entomology (Dr. C. Strickland) reports several studies on malarial mosquitoes—particularly *A. stephensi* as also other disease-carrying insects. The report of the Professor of Public Health Laboratory Practice (Dr. B. B. Brahmachari) contains a few interesting features among which mention should be made of studies in the Vitamin A contents and nutritive values of ghee and different vegetable oils. The researches on ghee would appear to require more extended observations with specimens from different sources before any generalisations could be made. The proposed survey of the fæcal flora is interesting but, in view of the inadequacy of the present-day methods of isolating and studying different organisms, it is hardly likely that any new improvements in the detection of sewage pollution of water could be effected.

The recent success of Napier and his co-workers in the transmission of Kala-Azar to Hamsters through the bite of sand flies has placed the inquiry on a sounder basis, but further work is needed to elucidate certain obscure aspects of that disease. Of special interest is the fact that the suspected carrier, *Phlebotomus argentipes* is entirely absent from at least one heavily infected area in Madras and that in the Rameswaram island where a great deal of anti-malarial work has been carried out, Kala-Azar has almost entirely disappeared.

The Professor of Chemistry (Dr. S. Ghosh) reports on his works on indigenous drugs and Vitamin B assay of Indian rice. In the latter case close correlation between results obtained by Spruyt's colorimetric method and feeding experiments with birds was observed.

In the Hookworm Research Department Dr. Maplestone and his associates found that the newly introduced anthelmintic hexylresorcinol was not so efficient as other drugs already in use: moreover, it appeared to be highly toxic under certain conditions of administration.

The enquiry of bowel diseases devoted considerable attention to the characterisation of different types of cholera phages. Some preliminary work on the nature of cholera toxin showed that it contains some compound with a free cyanogen radical. There is a suggestion that the poisoning of the human system is due to the absorption of hydrocyanic acid or one of its

related compounds together with other toxic amines.

The Leprosy Department under Dr. Muir extended its observations on the pathology and bacteriology of that disease. The intradermal method of giving hydracarpous injections has been found to be more effective than the intramuscular or the subcutaneous treatments. The lack of correlation between the lesions and the number of *M. lepræ* was the subject of careful research and the evidence so far obtained suggests that there is a minute form of the parasite which has not yet been recognized microscopically and that this germ is the usual cause of at least early nerve lesions. The nature of this virus and the possibility of its being filtrable are discussed, analogy being drawn to a filtrable virus in rat leprosy and tuberculosis stated to have been demonstrated by some workers. Although claims have been made by workers in other countries that the leprosy organism has been isolated, yet repetition of their experiments has invariably led to negative results. The department has also conducted extensive propaganda and issued the quarterly Journal, *Leprosy in India*.

In the Diabetes Research Department, Dr. J. P. Bose carried out studies on the distribution of sugar in the blood of diabetic and non-diabetic subjects as the result of which it has been concluded that (1) in normal healthy subjects the plasmic sugar is only slightly higher than the corpuscular sugar, while in diabetic subjects the plasmic sugar is always much higher than corpuscular sugar, and (2) the high plasma and the low corpuscular sugar is due to the inability of the corpuscles to take in sugar from the surrounding plasma.

The Filariasis Research Department under Dr. S. Sundar Rao investigated problems relating to (*a*) longevity and (*b*) different modes of infection with *Wuchereria bancrofti*. Several methods of treating the infection with compounds of copper, bismuth, tin, zinc and lead were tried but without success.

The report of Respiration Diseases inquiry (Lt.-Col. Acton) relates to a survey of different diseases affecting persons engaged on tea gardens or jute mills. Since a large number of mill hands suffer from asthma, considerable attention was directed to the early diagnosis of the different types of that disease. In the tea gardens, pneumonia is responsible for many deaths and a study of the nature of the organisms has shown that it belongs mostly to Type IV. The observation is now being extended with a view to producing a correct type of anti-serum for general use in India.

Radiology and Electric-therapeutic Department (Lt.-Col. J. A. Shorten) records several interesting clinical observations. The Superintendent of the Pasteur Institute (Dr. M. J. Nicholas) reports a number of cases of treatment for dog bite though for some unknown reason, many of the patients did not attend the full course of treatment. The general results show, all the same, a high percentage of success as a result of the anti-rabies treatment, the failures being, on an average, only 0.38 per cent of the total number of cases treated. The appendices include a report of the Secretary to the Endowment Fund of the Calcutta School of Tropical Medicine and lists of articles and books published or read by members of the staff during the year under report. Publications relating to the various subjects under review have been issued frequently chiefly through the columns of *Indian Journal of Medical Research* or the *Indian Medical Gazette*.

The U. P. Academy of Sciences.

THE *Bulletin of the U. P. Academy of Sciences*, Vol. 2, No. 4, May 1933, contains a report of the Proceedings of the Annual Meeting of the Academy held in the Vizianagaram Hall, Muir College Buildings, Allahabad, on Friday, Jan. 13, 1933. The Hon'ble Mr. J. P. Srivastava, M.Sc., (Tech.), Education Minister to the Government of the United Provinces, presided.

The Secretary's Report showed that the Academy had 102 Members on its roll of whom 19 were non-resident. Pandit Madan Mohan Malaviya was elected Honorary Fellow of the Academy in recognition of his eminent services in the cause of science and education in the Provinces. Dr. R. Samuel, R. F. Hunter and Dr. P. L. Srivastava were elected Fellows of the Academy. During the year, 43 papers were read before the Academy and its Bulletin received 53 Journals in exchange.

Dr. M. N. Saha, the President of the Academy, delivered his Presidential Address on the "Present Crisis in Dynamics". After reading a message from H. E. Sir Malcolm Hailey, Governor of the U. P., conveying his well wishes to the Academy, Dr. Saha referred briefly to important events of the Academy for the year and then proceeded to the main text of his address.

The Science of Physics is now passing through a great crisis. To be able to appreciate the present crisis, it would be interesting to recapitulate that the sciences created or inherited by the Greek and Hindu savants were all static, *viz*., Geometry, Algebra, Trigonometry and Arithmetic; they had no science to describe motion. Although they realized and saw around them Nature full of motion, the difficulties in arriving at its correct principles were almost insuperable. It was Galileo who, hemmed in and persecuted by an intolerant clergy, formulated his famous laws of motion. He gave a mathematical expression to 'mass', 'force', 'acceleration' and 'velocity'. But while in the sphere of physics and astronomy, these laws met with almost unlimited success, metaphysicians like Berkley and Hume objected strongly to Galileo's picture and propounded that the human mind must be taken into consideration in any world picture, a fact that Galileo's laws overlooked. To-day Berkley's ideas are found to be more correct than they appeared at his time. For 350 years the science of dynamics held supreme, for it provided an explanation of all known forms of motion and other physical phenomena. But when at the end of the last century it was found that electricity was more fundamental than matter, the first rift in the lute appeared.

It is curious that while classical dynamics led to the foundation of Einstein's 'Theory of Relativity', the theory itself shattered some fundamental concepts of classical physics. Classical dynamics assumed mass as an inherent property of matter, that space can be measured according to the principles of Euclid, and that time is a sort of uniform flux. The historic experiment of Michelson and Morley on ether drift led Einstein to postulate a four-dimensional space where time was continuous with space and points became events. Time ceased to be absolute and distance had no logical meaning. Mass was not an inherent property of matter and the coarser concepts of classic dynamics were replaced by the finer and more accurate principles of relativity ; space was not infinite nor possibly time.

In the sphere of intra-atomic physics, Planck's postulation of the quantum theory, which in the beginning was considered by many as an illusion, proved to be the *elan vitale*. But the ignorance of the actual value of the constant angular momentum of the H. proton was a great obstacle in the application of the quantum theory to the solution of atomic physics till Niels Bohr solved the difficulty. This then formed the basis of the explanation of all physical and chemical properties of atoms. According to this theory, the electron can occupy and move only in certain number of orbits ; also when the electron occupies one of the higher orbits, after some time it has to jump back into one of the lower orbits although it cannot be precisely stated to which orbit the electron would jump. This can be defined in terms of only probability. This brings us into conflict with the most fundamental concept of classical dynamics, *viz.*, the law of causality. The whole of classical physics is built on the principle that every effect has a cause and, if we deny this principle, we are going back to the days of the ancient philosophers who attributed everything to a Divine Will, and then no need for scientific enquiry exists. Bohr's idea shattered the theory of cause and effect by unwittingly endowing the electron with free will to jump from any one orbit to any other orbit.

The remarkable researches of the physicists replaced the original conception of the electron—the fundamental unit of matter—as something that occupies a Euclidean space point at a definite instant of time, by a minute solar system of a proton surrounded by orbits of revolving electrons. But the matter did not stop there. De Broglie went a step further and replaced the particle of negative electricity by a train of waves. This conception is in direct conflict with classic dynamics where the state of motion of a particle can be defined by its location, position and momenta coordinates. A train of waves cannot be defined in these terms and Heisenberg showed that this indefiniteness was inherent in the nature of things. A little reasoning will show that we observe a particle only by illuminating it with light and if the particle be of the order of the magnitude of an electron, the light itself will impart momentum to it as shown by A. H. Compton. Hence we can never perceive any electron in its natural state and consequently we cannot define its state. Schrodinger replaced De Broglie's wave train by a spherical vibrating elastic membrane and tried to bridge the difference between the classic and modern physics and retain the principle of Causality ; but there are many weak points in his theories that cannot be easily explained.

Repeated attempts have been made therefore by physicists to co-ordinate the various conflicting theories which have resulted in the formulation of a variety of symbols like Heisenberg's Matrices, Sixteen-Dimensional Geometry, Spinor-Analysis, etc. In many cases, one is left with the sensation that a mountain has laboured to bring forth a mouse and that too an indefinable one. Thus at present physics is full of speculations which need a mathematical Messiah to clear up. The Messiah is not yet in sight and the physicist, uncontrolled by any sobering influence, finds himself dazed by his own discoveries and inability to interpret his results.

The Hon'ble Mr. J. P. Srivastava congratulated the Academy on its successful working and its usefulness in the development of the Province. He hoped that the Academy would exert its influence in a greater application of science to everyday life which was the immediate need of the country. The average man may not take that interest in science if it were only theoretical as he would if it were more practical. The scientists can really offer a solution to the grave problem of unemployment facing everybody. He wished the Academy a long career of uninterrupted usefulness.

The following were elected office-bearers for the current year :—

President :—Prof. K. N. Bahl, D.Phil., D.Sc. *Vice-Presidents* :—Prof. M. N. Saha, D.Sc., F.R.S., F.A.S.B., F.Inst.P., P.R.S. ; Prof. B. Sahni, D.Sc., Sc.D., F.L.S., F.A.S.B. ; *Hony. Treasurer* :—Prof. D. R. Bhattacharya, M.Sc., Ph.D., D.Sc., F.Z.S. ; *General Secretaries* :—Prof. P. S. MacMohan, B.Sc., M.Sc., F.I.C. ; Prof. A. C. Banerji, M.A., M.Sc., F.R.A.S., I.E.S. ; *Foreign Secretary* :—Prof. N. R. Dhar, D.Sc., F.I.C., I.E.S. ; *Other Members of the Council* :—Prof. K. C. Mehta, Ph.D., M.Sc. ; Dr. S. S. Nehru, M.A., Ph.D., I.C.S., M.L.C. ; Prof. Ch. Wali Mohammad, M.A., Ph.D., I.E.S. ; Prof. K. K. Mathur, B.Sc., A.R.S.M. ; Dr. P. L. Srivastava, M.A., D.Phil. ; Prof. Robert F. Hunter, D.Sc., Ph.D. ; Dr. S. M. Sane, B.Sc., Ph.D. ; Prof. C. Maya Das, B.Sc., M.A., I.A.S. ; Prof. K. C. Pandya, D.Sc.

The Lady Tata Memorial Trust.

THE Lady Tata Memorial Trust was founded and endowed in April 1932 by the late Sir Dorabji Tata as a memorial to his wife, the late Lady Tata, in order to promote the advancement of medicine by research into the diseases of the blood, with special reference to the leucæmias. Under this trust, Sir Dorabji has set apart a sum of Rs. 25 lakhs, the income from which is divided into various awards.

One-fifth of the net income is ear-marked for the encouragement of research by Indians in India or abroad by the award of one or more prizes annually for the best work done in any scientific investigation which has a bearing directly or indirectly on the alleviation of human suffering. The rest of the income will be devoted towards research in disease of the blood with reference to the leucæmias by the award of prizes, scholarships, fellowships and grants-in aid of such work, and the awards will be open to candidates of any nationality including India. The trustees will be aided by a scientific Advisory Committee having its headquarters in London and including Continental representatives and by an Indian Committee in India.

On the occasion of the second anniversary of the death of Lady Tata, the Trustees announce the following awards:—

Four international scholarships, each of the value of £400 per annum:—

1. Dr. Walter Bungeler, Professor in the University of Frankfort-on-Main and physician at the Seuckenberg Pathological Institute, for research in the experimental creation of leukæmias by chronic Indol intoxication in mice, the influence of deranged products of metabolism in the production of Leukæmia and therapeutic methods of controlling them, under the direction of Professor B. Fisher Wasels, Director of the Pathological Institute of the University of Frankfort-on-Main.

2. Dr. Leonid Dolschansky, Assistant at the Pathological Institute in the University of Berlin, for research in Tissue Culture with reference to the dynamics of blood cell formation, under the direction of Professor R. Rossle, Director of the Pathological Institute in the University of Berlin.

3. Dr. Martin Cyril Gordon Israels, M.Sc., M.B., Ch.B., lately House Physician at the Royal Infirmary, Manchester, for research in the application of methods of Tissue Culture to problems of leukæmia and pernicious anæmia, under the direction of Dr. J. F. Wilkinson, M.D., Ph.D., M.R.C.P., Director of the Department of Chemical Investigation and Research at the Royal Infirmary, Manchester.

4. Dr. Charles Oberling, Professor, Faculty of Medicine, Paris, and Director of the Department of Experimental Medicine in the Institute of Cancer, Paris, for research in the transmissible leukæmias of hens, and their relationship to the sarcomas, under the direction of Professor G. Rousey, Professor of Pathology in the Faculty of Medicine, Paris.

Five Indian scholarships, each of the value of Rs. 150 per month:

1. Mr. Nirode Chandra Datta, M.Sc., Assistant at the Indian Institute of Science, Bangalore, for research in the contamination of foodstuffs due to the use of metallic vessels for cooking, storage and other purposes; its effect on growth and metabolism; and the effect of traces of copper and iron on nutrition, under the direction of Prof. V. Subrahmanyan, D.Sc., F.I.C., Head of the Department of Biochemistry at the Indian Institute of Science, Bangalore.

2. Dr. Sudhendra Kumar Ganguli, M.B., for research in Chemo-Therapy of anti-malarial drugs, under the direction of Lt.-Col. R. N. Chopra, I.M.S., Director, School of Tropical Medicine, Calcutta.

3. Mr. Narendranath Ghatak, M.Sc., for the chemical examination of certain indigenous plants of India, under the direction of Prof. N. R. Dhar, D.Sc., F.I.C., I.E.S., Professor of Chemistry in the University of Allahabad.

4. Dr. Mattengunta Venkata Radhakrishna Rao, M.B., B.S., for the chemical, biochemical and pathological investigation of "de-compensated portal cirrhosis" and allied diseases, under the direction of Dr. T. S. Tirumurti, B.A., M.B.C.M., D.T.M. & H. (London), Professor of Pathology at the Medical College, Vizagapatam.

5. Mr. Har Dayal Srivastava, M.Sc., for research in the life-history of Helminth Parasites of man and domestic animals, under the direction of Prof. D. R. Bhattacharya, D.Sc., Ph.D., Professor of Zoology in the University of Allahabad.

Humanity as a whole and India and her citizens in particular are beholden to the Tata Family for more than one benefaction. The Tata Iron Works at Jamshedpur, the Andhra Valley Electricity Scheme, the Empress Mills, the Tata Oil Mills, to mention only a few, stand as monuments to the great Mr. J. N. Tata as the pioneer industrialist of the country who saw that the progress of India lay in her rapid and efficient industrialization. The Tata Education Scheme is a source of immense help every year to bright young Indian students to go abroad and qualify themselves to high distinctions in all branches of learning. Every beneficiary under this scheme will without doubt remain ever grateful to the memory of the great educationist who felt the need for some means of helping deserving Indian students to make their mark in life and provided for it generously. The Indian Institute of Science, with its vast facilities for researches, stands as a striking tribute to the foresight of the great benefactor who so clearly and correctly estimated the value of a thorough scientific education on up-to-date lines in the future progress of India. Twenty-five years of its existence has justified his expectations only too fully, and in the ripe years to come, under the Directorship of Sir C. V. Raman, its future is truly great.

While all these schemes had their foundation in the foresight and wisdom of one of the greatest of India's sons, not a little of their successful fruition is due to the equally generous and enthusiastic support of his two sons, the late Sir Ratan Tata and the late Sir Dorabji Tata whose abiding interest in the progress of India in art, literature, science, and industry is probably unequalled. The latest gift of Sir Dorabji, made a few months before his lamented death, is one more instance of his generosity in the cause of science and the happiness of humanity. We sincerely hope that the several awards will result in great and useful contributions to science and to the alleviation of human suffering.

Research Notes.

The Influence of Ovarian and Anterior Pituitary Hormones on Calcium Metabolism.

THEODORE F. DIXON (*Biochem. Journ.*, **27**, No. 2, pp. 410-419) doubts, after experimental verification, the belief that internal secretions have some influence on the calcium metabolism of the body. Careful examination of serum calcium levels of rabbits and dogs after injection of the ovarian and corpus luteum extracts has shown no significant variation. Pregnancy also does not seem to produce any change in the calcium level of rabbits. No noticeable influence of anterior pituitary extract on the serum calcium level of rats is seen, even if the injection is sufficient to produce luteinisation of the ovaries. The older observations of Bell, Widdows and others suggesting changes in serum calcium levels in different stages of the growth of the reproductive organs in man are probably due to other causes. In animals, however, where, as in rabbits, the serum calcium level is variable even under normal conditions of diet, any estimations regarding the serum calcium levels are liable to be faulty.

Effect of Radium on the Metabolism of Cultures of Embryonic Kidney Tissue.

IT appears that the action of γ radiation on protein and carbohydrate metabolism varies. B. E. Holmes (*Biochem. Journ.*, **27**, No. 2, pp. 391-397) finds that a fourteen hours' exposure of embryonic kidney tissue to γ rays from 300 mg. radium in a platinum container ·5 mm. thick arrested carbohydrate breakdown while it produced no effect on protein breakdown. The contradictory results obtained by earlier workers like Crabtree and Krontowski were probably due to the faulty containers used which allowed a certain amount of β radiation. And the effect of β radiation on tissues is fundamentally different.

Studies on Cholera Bacteriophage.

ASHESHOV and his co-workers have published the first of three parts of their enquiry (*Ind. J. Med. Res.*, **20**, 1101, 1127 1159, 1933). The first part relates to the general technique and gives details of preparation of media, growth of cultures, isolation of the phages and such like operations; the second one is devoted to the classification of the phages on the basis of the Type-test; and the third part relates to the study of the virulence and development of bacteriophage. The defects in the previous methods of evaluating the potency of bacteriophages are indicated and a new one based on the rate of multiplication suggested. The above observations are of considerable importance and should eventually form the basis of an effective scheme of treatment for checking outbreaks of epidemics, but the intrinsic value of the publication has been vitiated by personal opinions which are not entirely supported by the observations. The text is also unnecessarily lengthy, the commonest details in bacteriological technique being described with the most elaborate care. It is hoped that the above defects will be eliminated from later publications.

The Cultivation of Cereals in Kent in the Thirteenth Century.

MR. R. A. PELHAM, M.A., of Birmingham University, has been unearthing in the Public Record Office some interesting information about the growing of grain crops in Kent during the 13th century. At that period military expeditions were common occurrences, and it was the duty mainly of the sheriffs to raise supplies of food and equipment from both laymen and ecclesiastics, the latter including the Archbishop of Canterbury, the Prior of Christchurch, Canterbury, and the Abbot of St. Augustine's, Canterbury, whose manors were dispersed throughout the county. The study of an account roll, which includes the names and contributors of nearly 700 people in Kent who supplied grain for an expedition to Gascony in 1297, has led to the somewhat startling inference that the distribution of wheat, barley and oats in Kent at that time was almost exactly the same as it is to-day, except in Romney Marsh, which was not then used for rearing sheep. Mr. Pelham, who writes in the *Empire Journal of Experimental Agriculture* (published by the Oxford University Press) concludes from his interesting study that although the tillers of the soil in the days before the Black Death may have used very wasteful methods of cultivation compared with modern practice, they were by no

means ignorant of the main soil conditions that their cereal crops required.

Comparative Effect of Tomato and Orange Juices on Urinary Acidity.

IT was reported by Saywell last year that several common fruits exerted a remarkable effect on urinary acidity of men and L. G. Saywell and E. W. Lane (*Journal of Nutrition*, **6**, No. 3, 263, 1933) have continued the work and determined the effect of tomato and orange juices on urinary acidity. An increase in the urinary pH is noticed though the average increase in case of orange juice is a little less than that of tomato juice. There is, however, a decrease in the ammonia excreted. An increase in the alkaline reserve and the organic acids excreted were the other significant changes in the urine.

Agriculture in the Empire.

[Views of Mr. J. H. Thomas and Major Walter Elliot.]

TO the first number of the *Empire Journal of Experimental Agriculture*, which has lately been issued by the Oxford University Press, the Secretary of State for the Dominions and the Minister of Agriculture contribute some striking expressions of their views on the fundamental importance of research work in the development of Agriculture in the Empire.

Mr. Thomas states that in agriculture, as in every other human activity, we seem to be passing into a new world. There never was a time when tremendous changes were more certain, when events were harder to forecast or when action was more difficult to plan. The founders of the *Journal*, he continues, have had the wisdom to discern and the enterprise to back the only certainty in sight, and they have recognized the one sure contribution which can be made at this moment to the future of the Empire Agriculture. That contribution is to provide that those who are responsible for guiding agricultural policy shall keep in close touch with one another and shall quickly pool for the common advantage every new fruit of discovery and invention in the field of agriculture. As Lord Balfour so truly remarked: "Let us cultivate easy intercourse and full co-operation will follow."

Major Walter Elliot welcomes the new *Journal* as a natural and valuable development from the Imperial Agricultural Conference of 1927, which did so much to foster among scientific workers in all Empire Countries the desire to combine their knowledge and to approach their tasks with the consciousness that the problems of agricultural science concern not only the parish or county or even the country but the whole world. Science knows no geographical boundaries and in an Empire which fundamentally is founded on agriculture, it is impossible to over-estimate the value of co-operative research work in agriculture.

Insect Transmission of Peach Yellow.

THE gray leaf hopper, *Cicadula sexanatota* Fall, which is known to transmit aster yellows to a large number of different plants including one species belonging in the Rosaceæ, is unable to transmit aster yellows to peach. L. O. Kunkel of the Boyce Thompson Institute now reports successful transmission of peach yellows by the leaf hopper *Macropsis trumaculata* (*Contributions to the Boyce Thompson Institute*, 5, 19, 1933). This was found in large numbers on peach trees. It occurs also on plums. It never hops but runs rapidly and hides very well. It scarcely flies except when closely pressed. The adults and nymphs generally feed on twigs and large branches, and are only occasionally found on the leaves. Because the insect produces only one generation in the year, experiments are difficult. The insects were fed on diseased peach seedlings confined in insect-proof cages for varying times. They were then transferred to healthy seedlings. The trees were all kept in green house which was frequently fumigated to keep free from sucking insects. But one drawback is that seedlings on which insects have been fed suffer from wilting which depends on the number and time allowed. The cause of wilting could not be traced to any bacteria or fungi. Probably the insects inject some deleterious substances that cause wilting. The percentage of successful transmission of disease was only 10. Several other species of insects including aphids and borers were tried for their ability to transmit the diseases without any success.

Science News.

The Chromosome Number of Crotalaria juncea Linn.: Mr. R. M. Datta, Department of Botany, Presidency College, Calcutta, reports as a result of his investigations that the metaphase plate in the pollen mother cells shows the haploid number to be 10. It may be remembered that Messrs. S. Ramanujam, N. Parthasarathy and K. Ramiah of Coimbatore Agricultural Research Institute, who have worked on four species of *Crotalaria* of which *C. juncea* is one, have reported at the Patna Session of the Indian Science Congress that the haploid number is 8.

* * *

In reply to Dr. S. L. Ghose's note on *Mosquito and Charophyta*, (*Cur. Sc.*, **1**, 328, 1933) Mr. S. C. Dixit, Wilson College, Bombay, in a short note addressed to us gives the following list of species of Charophyta having no larvicidal properties which are met with in Santa Cruz. (1) *Nitella hyalina*, (2) *Charasuccincta*, (3) *C. flaccida*, (4) *C. zeylanica*. Mr. Dixit observes that opinions freely expressed in journals on scientific matters could not kill further research on this subject.

* * *

The Imperial Institute, South Kensington, announces a forthcoming publication on "Lead: Its Occurrence, Uses, Mining and Metallurgy".

* * *

Marriage Ceremony among the Vaishnava Castes in Bengal: Mr. Keshava Sharan Agarwala of Poona, in an interesting short note on the marriage customs of this important community, condemns the lavish expenditure on social functions attending marriages and has pointed out that according to the *Sastras* the religious and the more important part of the function is comparatively simple and inexpensive. A mere exchange of "Kanthi" or a garland of beads between the bridegroom and the bride is according to him sufficient to constitute a valid marriage. But societies and even governments are under the tyranny of customs and traditions and the force of Hindu Law is more honoured in the breach than in the observance, even in semi-religious functions. Mr. Agarwala sees little or no significance in the social practices.

* * *

We have pleasure in congratulating Dr. Karam Narayan Bahl, Professor of Zoology, University of Lucknow, on his election to the Presidentship of the U.P. Academy of Sciences. We wish him and the Academy an uninterrupted career of increasing usefulness.

* * *

At the ordinary monthly meeting of the Asiatic Society of Bengal, held on Monday, the 3rd July 1933. Mr. K. P. Biswas read a paper on 'Living Conifers of the Indian Empire'.

Conifers form an important source of revenue of this country. They are also extensively cultivated in gardens throughout India, Burma and Ceylon for ornamental purposes. The present paper contains a list of 106 species of Conifers at present living within the Indian Empire (with inclusion of Ceylon) to be regarded as a working list to which perhaps additions may be made in the future, arranged alphabetically under a systematic system of nomenclature according to the rules laid down by the Vienna Congress of Botanists in 1905, and subsequently endorsed by the Horticultural and Botanical Congresses in 1930. The locality of occurrence in India and Ceylon is noted under each name. An attempt is made to define whether species are wild or cultivated, and in the latter case when and where introduced. Twenty-three Indian wild species are recorded, representing 21 per cent of the total number. Percentages amongst introduced species are: Chinese and Japanese 21; American 15; European 11; African 4; Pacific and Atlantic 8; Australian and New Zealand 6.

Dr. Baini Prashad exhibited certain Molluscs damaging the brickwork in the King George's Dock, Calcutta.

* * *

The Third International Congress of Experimental Cytology will be held at Cambridge in August from the 21st to the 26th. Prof. Th. Huzella, Professor of Anatomy in the University of Debrecen, is the President of the Congress and his presidential address will be on "Culture des tissues en ses relations aux problemes generales de la biologie et aux problemes speciales de la medicine". The chief features of the Congress will be discussions on the following topics:—"Cell Respiration and Cell Metabolism", "Cell Form and Function as demonstrated by Recent Advances in Tissue Culture", "The Electrophysiology of the Cell," "Entwicklungsmechanik and Explanation", "The Cultivation of Animal and Plant Viruses". Further information concerning the Congress can be had from Dr. Honor B. Fell, Strangeways Research Laboratory, Via Cheryhinton, Cambridge.

* * *

Messrs. Adam Hilger Ltd., have put on the market a new X-Ray Fibre Spectrograph which has been designed by W. T. Astbury, B.A., of the Textile Research Department of the University of Leeds for the investigation of all types of fibres, *e.g.*, wool, silk, cotton, hair, etc., and is now used in his X-Ray researches. The apparatus renders possible the study of the behaviour of these substances under a variety of conditions, such as tension and humidity and thus yields important information on the effects of wear, or of processes of manufacture, upon textile materials. With its accessories it provides a complete equipment for X-Ray fibre research and should prove indispensable in every textile research laboratory.

* * *

Sir George Anderson, till recently Director of Public Instruction to the Government of the Punjab, has been appointed Educational Commissioner to the Government of India in succession to Mr. Clarke. The Government of India is seriously considering the revival of the All-India Board of Education which was abolished nearly a decade ago and it is understood that Sir George Anderson will be entrusted with the task of its reorganization.

* * *

We have received a copy of *Electrotechnics*, No. 6, April 1933, published by the Electrical Engineering Society, Indian Institute of Science, Bangalore. Besides notes about the new equipment and research work of the Department of Electrical Technology of the Institute, the journal contains articles on "Preparation for Leadership"

by Dr. M. O. Forster; "Mercury Arc Rectifiers with Control Grids" by Prof. J. K. Catterson-Smith; "The Measurement of the Frequency of Electrical Oscillators" by S. K. Kulkarni Jatkar and Dr. H. E. Watson; "Echo Suppression in Wire and Radio Telephony" by S. P. Chakravarti; a description of the total solar eclipse in Canada; a note on frequency standards and measurements; a resume of polyphase compensated commutator induction motors by Dr. J. J. Rudra and abstracts of lectures and papers read before the Society during the year 1932. The personal notes about members of the Society, reviews of books and other news of the activities of the Society make the publication, which is priced at Rs. 2 only, interesting reading.

* * *

As we go to Press, we have received a copy of Sir M. Visvesvaraya's illuminating address, "Industrializing India," delivered before the Mysore Chamber of Commerce on the 10th July. The opinions of such an eminent statesman as Sir M. Visvesvaraya, coming as they do, on the eve of the Simla Conference convened by the Government of India, are entitled to great consideration and we hope to review them in these columns shortly.

We acknowledge with thanks the receipt of the following:—

"Canadian Journal of Research", Vol. 8, No. 4.

"The Review of Scientific Instruments," Vol. 4, Nos. 1 to 5.

"Journal de Chimie Physique," 25th April 1933.

"The Journal of Chemical Physics," Vol. 1, No. 5.

"Nature," Vol. 131, Nos. 3315 to 3318.

"The Chemical Age," Vol. 28, Nos. 724 to 727.

"Medico-Surgical Suggestions," Vol. II, Nos. 5 and 6.

"Bulletin of the U. P. Academy of Sciences," Vol. 2, No. 4.

"The Biochemical Journal," Vol. 27, No. 2.

"The Indian Forester," Vol. 59, No. 6.

"Scientific Indian," Vol. 9, No. 53.

"International Geological Congress—Sixteenth Session," U.S.A. 1932. (Pamphlet.)

"Electrotechnics," No. 6, April 1933.

"Journal of Agricultural Research," Vol. 46, Nos. 6 and 7.

"The Journal of Nutrition," Vol. 6, No. 3.

"Half-Yearly Journal of the Mysore University," Vol. 6, No. 1.

Reviews.

HISTORY AS A SCIENCE. By Hugh Taylor 1933 (London: Methuen & Co., Ltd., W.C. p. vii+138, price 7/6 net.)

The book is undoubtedly a scholarly production. The author has treated the subject with insight and originality, creating a new atmosphere for history.

If the function of science is to investigate the facts and phenomena in the realm of reality, it is clear that the claims of history to be ranked as science are admissible. To forbid them is to set up a wholly arbitrary restriction of science. If the social phenomena present features which do not lend themselves to theoretical treatment by methods devised by other branches of natural science, the proper procedure for history would be to devise its own technique for dealing with them. Everyone is at liberty to define Science as he pleases, but no definition can be permitted to fly in the face of the actual state of affairs. This would happen if we restrict the definition to mathematical physics. We would be making a fatal error and injure an epoch of scientific thinking if we consider that no branch of knowledge which does not lend itself to physico-chemical technique is entitled to be called science. On the other hand, science is an attempt to bring facts into logical order. History inherently is incapable of introducing measurements in its technique and may be incapable of expressing its general conclusions in precise mathematical formulæ. But this defect alone will not invalidate history to be treated as a branch of inexact sciences.

In the opening chapter, the author points out that the difficulties which beset the study of history arise from the fact that it is simultaneously concerned with the interests of both conduct (morality based on religion) and knowledge. Taylor thinks that in a conflict of science and religion, the cause of the latter must have a wider following, because a stable society based on orderly life is a condition precedent to the progress of science. In the first place, science is not opposed to religion in the higher sense of the term and both represent two avenues of approach to truth. But science has no patience with dogmas, creeds, ritualism, superstitious beliefs and sectarianism which are beyond verifiable facts. True religion is based on dependence of life, which is the ultimate and fundamental fact of existence; and human heart, whatever the head may dictate, instinctively yearns for succour in moments of despondency and helplessness and the existence of a Supreme Being, science can neither corroborate nor disprove. The modern tendency of science is to become metaphysical and sooner or later must accept the first postulate of a Great

Cause whose laws it is attempting to unravel. We do not agree that the cause of science is opposed to that of morality or right conduct or true religion and it is unnecessary to make extravagant claims on behalf of the latter to establish its superiority. Any attempt to do so is apt to land one in an untenable position. For instance, when the author says that men must live (society based on conduct) before they can know, the dictum is true of a social order under the control of a governing authority, but not of primitive society. Primitive man sustained himself not through the mystical charms of the Ten Commandments but by his skill in hunting, and dissimulating by lying concealed near the water holes and imitating the calls of animals and in circumventing the pursuits of his antagonists. The exploded controversy of the nineteenth century which raged over the conflict of science and religion has no basis in fact if we define and delimit the connotation of the latter term and is unnecessary to be evoked as offering difficulties to the interpretation of the social progress and political achievements.

The object of history is defined as the discovery of the principles of human evolution and the whole book is devoted to defend this thesis. There is one point in the discussion on which we are inclined to be sceptical. The truth which the historian sets out to discover is not of the same order as the one which falls within the province of the scientific investigators. If the apparatus is arranged without initial error or defects in the parts, then the observed facts cannot be far from truth, unless the observer is careless or clumsy in his interpretation. The material on which the historian works is human document which at the time of preparation cannot but be coloured by the passions and prejudices of the times. The very source is vitiated. If in 2014 A.D. the future historian were to proceed to investigate the truth about the Great War, he has to rely on the evidence of despatches, bulletins and other documents which the belligerents and the allies have published from time to time and each presents his case from his standpoint, in defence of his actions. These evidences on which the historian has to work will not have the same value as the facts presented by an experiment.

For purposes of a scientific history which deals with the evolution of social and political institutions, mankind will have to be treated as a single unit and obviously this is impossible, for the ethnological, cultural and social differences among the races are too wide and deep to be brought under one general theory. But nevertheless the great events of nations and the factors of their evolution must have a common substratum capable of a scientific treatment. Scientific history is possible and even metaphysical history. But we prefer, we confess, Macaulay, Green and Froude to Seely, Mahan and Lord Acton. The narrative history has always an irresistible interest to man who is deeply concerned with the personal triumphs of his ancestors, their tastes, manners, dress, social weaknesses and strength, public amusements, their pains and their graces, their joys and tragedies, their forms of government and their public finance and foreign relations.

We have read this book with great profit. It opens out new fields of investigation and invests history with a new and attractive garb. Frankly, historical works written on the lines suggested by the author, must be invaluable contributions to historical literature.

* * *

RESPIRATION IN PLANTS. By W. Stiles and W. Leach. (Methuen & Co., Ltd., London, 1932. Price 3*s.* 6*d.*)

In this small monograph of 124 pages on respiration in plants, the authors have been able to compress a good deal of information which, as they themselves say, is readable and understandable by the elementary student in Botany, and is also of value to the advanced student. In the four chapters into which the book has been divided, the authors have endeavoured to marshall facts, quoting recent researches of a fundamental nature only, with a view to lead the student of the subject into estimating a correct picture, as far as possible, of the cell dynamics concerned with this fundamental property of the living matter, *viz.*, Respiration. Chapter I deals with the physiological importance of the process in the living mechanism of the plant, *viz.*, the release of energy by a process of dissimilation of substances of a higher energy content. Chapter II deals with respiration of normal plants under aerobic conditions where the variability of the respiratory intensity under various conditions of development, season, and other interval changes in the plants and plant organs, and also under

the influence of external factors, is discussed. Chapter III deals with anaerobic respiration where, without making an attempt to connect it with the aerobic respiration, the authors have presented significant facts to prove the general existence of respiration without oxygen, the production of alcohol, the similarity of effects of external agencies on the intensities of aerobic and anaerobic respirations and the variability of the ratio of the anaerobic to the aerobic respirations in different plant organs. Of particular interest is their discussion of the behaviour of ripening apples on transference to nitrogen from air investigated by Blackman and Parija, where a rise of respiration takes place under anaerobic conditions, a behaviour which, though exceptional, may, in the authors' opinion, be a common feature characterstic of senescent fruits. Chapter IV which deals with the Mechanism of Respiration in plants, is a digested summary of investigations on plant respiration. After discussing the general nature of fermentation in the yeast cells, the authors have given a concise account of oxidising systems in plant and animal cells, including the non-enzymatic oxidising systems, such as, the Glutathione of Prof. Hopkins. They next pass on to a sufficiently exhaustive discussion of the stages in the respiration process, where the latest views are quoted and summarised, holding respiration as a balanced reaction commencing from the reserve respirable material and ending in its complete oxidation to substances of least energy content, such as, CO_2 and H_2O. During this process many intermediate reactions occur, such as the hydrolysis of the reserve material, its activation prior to oxidation, the glycolysis of the activated material and finally the respiration of these substances under either aerobic or anaerobic conditions. The quantitative output of the end-result would depend upon the working of this series of balances in the reactions involved. The latest scheme which presents these balanced reactions in something like a conceivable picture of the actual events which may be taking place in the plant cell is that of Blackman based on Parija's observations. Of the greatest interest to the biologists is Blackman's conclusion that oxygen plays a double part in plants, *viz.*, direct oxidation in the final process of respiration and an earlier influence altering the rates of production of the substrates which are utilised in the final stage of respiration. This substantiates in an experimental way the general idea that oxygen (the "vital air" of the biologists) has manifold effects in various directions in the life-reactions of the living cell.

Though the authors cannot claim to have a thorough knowledge of the chemical aspects of the problem, they have been able to present a clear and concise discussion of all the chemical reactions which are known to be concerned in the process of respiration. The book, being a good summary of the more important recent work on this physiological process, should prove very useful to the teacher, the student and also the investigator. This is perhaps the first monograph in English by English authors of the recent work on respiration which, though concise, is sufficiently comprehensive.

R. S. I.

* * *

FIRST PRINCIPLES OF TELEVISION. By A. Dinsdale, pp. xv + 234. (London. Chapman & Hall, Ltd., 1933. Price 12*s.* 6*d.*)

Progress in Television has been so rapid in the past few years that it is difficult for an author to bring the various practical methods and systems that are in vogue, and arrange them in the proper sequence so as to be easily understood by the general public. The author of this book has very wisely sifted the whole field and presented in an interesting manner what is necessary, to serve as a good background to a proper understanding of the subject.

A few pages have been deservedly devoted to the elucidation of some elementary principles in optics without which it is difficult for the layman to comprehend the various operations involved. The chapters discussing the various systems are well laid. It is particularly interesting to note that the author has taken considerable pains to review the present state of Television in various countries without forgetting even the most recent private demonstration which he saw in America.

The book is eminently suited for all those who want to have a general idea of the principles involved in Television, though the author would have catered for a wider circle had he included a few chapters for the serious experimenter. However the non-technicality of the language and the interesting way in which it is written render the book well worth the attention of all those interested in the progress of Television.

C. CHANDRASEKHARIAH.

GENERAL MECHANICS. By Prof. Max Planck. Translated by H. L. Brose. (London: Macmillan & Co., Ltd., 1933. Price 12*s*.)

Prof. Max Planck's book on "General Mechanics" is an elementary book on the subject which is divided into two parts, *viz.*, "Mechanics of a Material Point" and "Mechanics of a System of Material Points" including mechanics of a rigid body. Part I is divided into six chapters which deal with motion in a straight line and in space, central force, potential, integration of the equations of motions, relative motion, and constraints. Part II is divided into four chapters which deal with Statics and Dynamics of a rigid body; and Statics and Dynamics of an arbitrary system of points.

The beginner, who tries to learn mechanics, feels the difficulty in understanding the physical ideas underlying the different systems in mechanics. It has been the aim of the author to explain in an elementary way the physical motions involved in mechanics. He has also endeavoured to present the structure of mechanics as something evolved step by step. He has therefore departed from the traditionally prescribed method of presenting the subject as a finished product. The traditional method may be effective from the practical point of view, but is open to criticism not only on logical grounds, but also to the fact that it is likely to confuse the beginner who wants to grasp the physical principles underlying the Science of Mechanics. In several cases, the author sacrificed conciseness and elegance, and the proofs he has given are not necessarily short and elegant ones, but they are generally very lucid and suggestive. Instead of placing "ultimate definitions" at the beginning of ready products, the author, by discussing definite problems, has tried to show how these definitions became necessary and useful.

It is doubtful whether many scientists will agree with the author that "the enunciation of Newton's Law of Gravitation is not *au fond* an expedient invention, but rather it is to be regarded as an epistomological discovery". In this book "Vis Viva" and "Kinetic Energy" have been used synonymously whereas English Mathematicians usually define "Vis Viva" as twice "Kinetic Energy". By introducing an interesting little dialogue the author has explained quite effectively that a couple can be transported to any position in its own plane without altering its physical meaning. Every student of Physics and Mathematics should read this book.

A. C. B.

* * *

A TEXT-BOOK OF CHEMISTRY. By H. A. Wootton and C. W. R. Hooker. (Pp. 488. Cambridge: The University Press. Price 6*s*.)

The portion of the book dealing with theory is well written and most of the chemical terms are explained in detail as they occur. The descriptive portion of the book is ill-balanced; while the non-metallic elements and their compounds have been dealt with in some detail the treatment of the metals is meagre. The metallurgy of even technically important metals like aluminium, lead and copper is disposed of in a few sentences. The periodic classification is not dealt with at all. Further a few advanced ideas are introduced at too early a stage for the young beginner in Chemistry to appreciate or understand. The second part of the book contains instructions for practical work in fairly good detail; there are chapters dealing with practical work like preparation of substances, volumetric anlysis, etc. The authors of the book have attempted to bring forth a volume which is ambitious in its scope. Naturally it has not been possible to do adequate justice to all branches of Chemistry.

The book can only be recommended to Libraries as a volume for general reference but it is not suitable as a text-book.

M. SESHAIYENGAR.

* * *

FOUNDATIONS AND METHODS OF CHEMICAL ANALYSIS BY THE EMISSION SPECTRUM. Being the authorised translation of "Die Chemische Emissions spektralanalyse". By Dr. Walther Gerlach and Dr. Eugen Schweitzer. (Adam Hilger Limited, London, 1933.)

Although it is only three years since "Die Chemische Emissions spektralanalyse" was published it has proved so valuable to workers in the field that an English translation of it should be welcome to many.

The English edition has departed from the original only in two small sections. Table VIII on page 80 provides additional data for the quantitative estimation of iridium in platinum. The section on spectrophotometry is somewhat amplified by a description of Twyman and Simeon's arrangement and a short description of

Schwarzschild's law of equality of blackening of the photographic plate.

The get-up of the book is excellent.

K. R. K.

* * *

FLIGHT OF FISHES. The mechanism, duration and extent of the flight of fishes are subjects of perennial interest to scientists and laymen alike. It is a matter of great pleasure, therefore, that Dr. Carl L. Hubbs in a recent contribution (*Papers Michigan Acad. Sci. Arts and Letters*, 17, 575, 1933) has recorded detailed and comprehensive field observations on the flight of fishes. The extensive data thus collected have enabled him to make a statistical study of the flight of the Cypselurinæ, the true flying fishes, and to make remarks on the evolution of the flight of fishes. There is ample justification for Dr. Hubbs' remarks that "too much of what has been written" about the flight of fishes "has been unduly deductive. Many have argued from pre-conceived ideas of the flight of birds, or from generally erroneous conceptions of the mechanics of flight, just how fishes must fly." Dr. Hubbs carried out his observations in 1929 "in the East and South China seas, about western Java, and around the entire main island of Japan," but most of his studies were done during the first half of June in the course of a journey "from Java through Java Sea, Straits of Macassar, Celebes Sea, among the Philippine Islands, and on to southern Japan." The small size of the steamer, in which Dr. Hubbs made his trip, and its slow speed were most favourable for carrying out this type of work.

As a result of these field studies we now know the flight of the most primitive flying fish, *Oxyporhamphus*. It consists of a low, single leap of about 5 to 8 metres. *Exocœtus*, in which only the pectorals are enlarged and hence called Monoplane Flying Fishes, also makes simple leaps of about 10 to 20 metres. In the Cypselurinæ, in which both the paired fins are enlarged — Biplane Flying Fishes, flight of fishes reaches its ultimate perfection. In this group flight is initiated by the surface skimming or taxi movements, and the sole propulsive power is provided by the side-to-side sweeping of the caudal fin. Once the fish is actually in the air, there is no further acquisition of power, except such as may be derived from favourable utilization of air currents. The longest single flights were of 12 and 13 seconds; the longest compound flight, when there are successive leaps, was almost 30 seconds. The average speed attained in the air is about 10 metres per second.

The mode of surface skimming, the position and function of the fins in flight, the control of flight direction, the duration of the flights, the number of successive leaps and the methods of return to the water are all elaborately described. The function of the wings of young flying fishes is also indicated.

Reference is also made to the flight of certain fresh-water fishes and it is concluded that "many fishes make leaps of varying length and perfection. Certain of the Percesoces are adept at leaping. Some of the relatives of the flying fishes leap; others only skim the surface. These two types of aerial locomotion were probably independently evolved. Since some flying fishes merely leap, whereas others initiate their flight with surface-skimming or taxi, doubt is thrown on the monophyletic origin of flight in the true flying fishes."

S. L. H.

INDIAN INSTITUTE OF SCIENCE

BANGALORE. INDIA

Applications are invited for the Professorship of Organic Chemistry on a salary of Rs. 1,000-50-1,250 with an overseas allowance of Rs. 250/- per month with free quarters. The appointment will be for not less than five years in the first instance.

Six copies of the application and of the testimonials, and two sets of the published papers of the candidate (which will be returned) should reach the Director not later than 30th September, 1933.

1222-33. Printed at The Bangalore Press, Bangalore City, by T. Subramania Aiyar, Superintendent, and Published by K. S. Varadachar, M.A., M.Sc., for the "Current Science" Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore.

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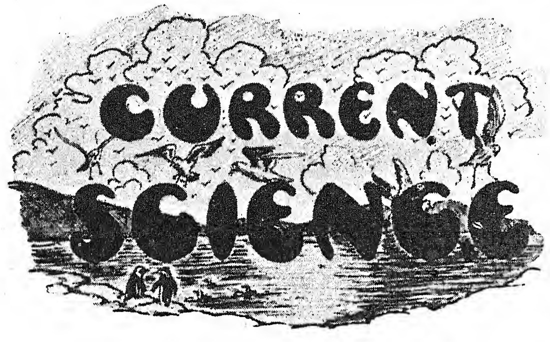

Vol. II] AUGUST 1933 [No. 2

CONTENTS.

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University Reform—I.

We hoped to be able to offer our observations on the Report of the Punjab University Committee in this month's issue of *Current Science* but though we applied to more than one agency for a copy of that undoubtedly interesting document, we were unable to procure one in time. Anticipating its arrival we propose to record here a few general reflections on the lines of reform along which the universities might develop their resources and extend their sphere of usefulness.

Broadly speaking, the character of a modern university is moulded by three well-defined influences. The first of these is the type of knowledge which it seeks to promote. This obviously has an important bearing on the organization of research and the curricula of studies. The second influence is that of the quality and type of citizen which it intends to produce. The power of a university to raise a body of leaders in thought and action depends on its cultural traditions, its reputation and atmosphere built up by its ideals. The third kind of influence which affects the complexion of a university is the nature of the political, social and economic environment in which it is situated. Theoretically it is true that the higher interests of the universities should not be subordinated to the obligations of financial assistance which they receive from the governing authorities. There is bound to be difference of opinion as regards the extent to which the vital forces of the country can be permitted to impinge on the legitimate functions of the universities, but there can, however, be little doubt about their attitude towards national problems.

Recently Indian universities have unfortunately been subjected to public criticism from more than one standpoint. They are regarded as the direct cause of unemployment and therefore, among the proposed remedial measures to overcome the evil, suggestions are made to convert them into technological institutes. Despite all criticisms, no university in India can relinquish its position as 'a corporation of teachers and students devoted to the quest of truth' nor can it give up its function of educating the latter to responsible membership and collaboration in the practical endeavours of society so that 'the national and cultural welfare of the people as a whole may be served'.

It seems to us that we should be taking a narrow view of the functions and responsibilities of the university if they are confined to the preparation of students to be scientific researchers, good doctors, lawyers, administrators, engineers, financiers, industrialists and politicians. The empire of the university is the whole range of the human mind and by virtue of the academic prestige it enjoys and the mass of knowledge it possesses, it has acquired virtually the competence to offer solutions to world problems. The policy of non-intervention in affairs lying outside the academic sphere has tended to preserve the freedom of learning and thought and its abandonment may be desired only if it does not involve the sacrifice of liberty. Frequently the universities become involuntarily incorporated into the political, social and economic structure of the State. In countries like Italy and Russia the universities have become subordinate branches of the State which prescribes their policy, directs and controls their academic functions. Though the German universities are practically all of them State institutions they enjoy greater freedom, but it is not unlikely that the Nazi idea of the Nordic Superman may soon supplant their old ideal of humanism. It is only natural that the tendency to concentrate on matters and activities outside the university should be strongest in countries which have broken loose from the pre-war academic traditions. In France and England the continuity of educational ideas is still maintained because the social and political facts of these countries have not undergone such a radical transformation as has overtaken the Central European States. 'Plans of reform in France and England have been confined to adjustment of the universities to the increasing demands of an enlightened democracy' and questions such as access to the university and the selection of students for higher training have claimed greater attention. In the United States learning is made subservient to the immediate practical ends of the people and the tendency to give university education to the maximum body of students has admirably built up American democracy.

Proposals of reform generally deal with the technical aspect of university education and the powers and constitution of university bodies. We sometimes shorten certain courses, add new faculties, prescribe more books, stiffen and prolong examinations, enhance fees and demand longer attendance, discuss rules and regulations, become jealous of powers and privileges of authorities and also take into account matters outside the university such as hostels, sports and unions. None of these things can have real significance unless we have a clear conception of the university itself. The new universities cannot afford to remain in cloistered seclusion impervious to the impressions of a rapidly changing world. They must be nurseries of big ideas and big men. If the universities have a limited programme it is no doubt true that they are likely to achieve definite results and one of them must be to train the intelligence of young men so as to enable them to turn their talents on any human enterprise with success.

One of the causes which militate against the attainment of this modest ambition is the large number of students the universities are required to handle every year. The result is a tendency to mechanize the mind by reducing human contacts to the minimum. The situation becomes almost tragic when we turn to the students. The pressure of numbers precludes them from imbibing the traditions of university life and from completely understanding the teachers whom they meet. So the world of students touches that of teachers only at official points and few other bridges are possible to be established. The young men desire leadership and we can offer them none to guide and instruct them in the affairs of the world. They wish for certainty and clear definition of the aims of popular movements and we give them no fresh ideas that fire their imagination. When confronted with situations which do not satisfy their higher intellectual ideals, the students look upon the university instruction as little better than a preparation for obtaining a livelihood. True, they acquire an enormous knowledge of disconnected facts and pass examinations. These lead them nowhere. Their inner intellectual restlessness and teasing doubts do not find a satisfactory answer and their labours in the class room do not provide them with employment. It should be no wonder that in such circumstances they should listen to the voice of the false prophets and follow them in the forlorn hope that 'their teachings will lift them ultimately out of their physical and mental misery'. They have faith in them because they are convinced that these leaders are nearer to the realities

of life than their teachers and also because they imagine that, out in the heat and tumult of popular agitation, there is baking for them the bread for the satisfaction of their intellectual and physical hunger.

The interests of our generation are fundamentally economic and it will not be possible to prevent young men from entering the universities in increasingly large numbers to avail themselves of university education as an equipment for careers in life. Few of them can afford to take the academic type as their ideal of university training. The reaction of the university to this influx is to impose hypertrophied qualifications by a continuous stiffening of the course of study and standards of examinations. A few years ago the rise in the number of students used to be enthusiastically welcomed as a sign of increasing national progress but to-day we are unconsciously striving to limit the admissions. The growing number of students is more an index of their distress from which they hope to seek temporary relief in the university. The idea of mass education in a university is opposed to its character as a home of culture. An overflowing class offers no opportunities for personal contacts, effective collaboration in studies and practical participation in research. When lectures are to be addressed to a vast body of students it becomes an anxious question whether every member is kept diligently employed and whether they are not otherwise industriously occupied. We can hardly blame them. The pressure of economic necessity weighs too heavily upon them to realize that university life is a time of carefree enjoyment of a series of intellectual banquets. When we realize how many students are obliged to earn while studying and how incessantly they have to toil, we should be less hasty in pronouncing judgment on the great transformation of character which distinguishes the present from the past generation of students. We should not at the same time forget that the bulk of them belong to social orders from which they inherit no pronounced predisposition to learning. The present period is really a crisis in learning and as a period of transition its problems must necessarily be complex.

We hardly succeed in getting an insight into the mind of the younger generation to whom university reform is only a part of universal reform of human society. The university secluded from town life has no significance to them who wish to keep in lively touch with its bustling activities. They want really a university which can equip them far more efficiently than before for the service of the people and the state. They wish to become prosperous citizens, capable leaders, efficient businessmen and wise administrators. They see disintegration of the old social order and hope to assist in building up a more stable one on a rational basis,—essentially human. They wish to see the inauguration of the new state with a new type of "full man" bringing with him a purer code of morality and social justice. The "economic man" has not satisfied their higher impulses nor have his doctrines enabled them to see visions of universal harmony and peace. Do the universities provide such a type of student with a satisfactory answer, offering him opportunities to realize where dreams end and where hard matter-of-fact life begins? The idealism of youth is an excellent asset for the university whose existing machinery, however, is ill-adapted for transforming it into an efficient instrument of service.

Besides dreams of service, the heart of the student is filled with ideas of liberty which for lack of clear interpretation are likely to be misapplied. It is true that 'life without liberty has little significance,' but the liberty which gives ethical reality to man disciplines his mind, promotes respect for ordered society and delights in the supreme joy of labour. Has the student opportunities of conversing or consulting with maturer minds in order to realize that 'liberty which is not love is nothingness' and that it is 'a negation of society'? Liberty in the higher sense of the term is the will to strive, to serve and to act faithfully and dutifully. In the hurry and distraction of modern life the word liberty is misunderstood in its real scope and in its implications.

The student is the hub of the university. The teachers and all the paraphernalia of education gravitate towards this human pivot. In reforming the university the student problem is undoubtedly the most difficult and puzzling. Recasting of studies, examinations and everything else is easy, for they are all immaterial and any number of alterations of these will not enable the university to fulfil their higher functions unless and until the growing human mind in all its myriad complexities is brought to respond to the reforms sympathetically, nobly and fully. No university reform can be satisfactory if it is not intended to foster

in the mind of the student and that of the teacher 'the idea of the oneness of knowledge' and to emphasize that 'scholarly work is service to civilization'.

Sir Richard Gregory, Bt., F.R.S.

THE tidings that Sir Richard Gregory, editor of *Nature*, has been elected a fellow of the Royal Society will have given wide-spread satisfaction among those who enjoyed the privilege of meeting him and Lady Gregory during their visit to this country in January and February of the current year.

Among the statutes of the Royal Society is one, seldom brought into operation, enabling election of a personage who, in the opinion of the Council, has rendered conspicuous service to the cause of science, or whose election is deemed to bring signal benefit to the Society. It has been customary to elect successive Prime Ministers under this statute, but we do not recall its application to other persons of eminence. Thus a special interest attaches to the election of Sir Richard Gregory, whose service to the cause of science is indeed conspicuous. During an association with *Nature* extending over forty years, and particularly under his long continued editorship, the publication has become unique. Its wealth of information in all branches of science, the courageous and broad-minded survey of such current affairs as relate to the progress of science, the cultivated and informative reviews of books, and the diverse correspondence columns, are features now so familiar to the scientific world that we can appreciate them at their true value only by considering for a moment the blank in our lives that would ensue were *Nature* to vanish.

On behalf of our readers we offer Sir Richard Gregory the warmest congratulations of *Current Science*. Since his return to England Sir Richard has been gravely ill, but the mail announcing his new distinction announces also his convalescence, and the hope that his health may be soon restored to its original vigour will be universal.

Joseph Priestley, 1733-1804.

THE bicentenary of Priestley's birth on 13th March, 1733, received special recognition by the Chemical Society at its meeting on 6th April, 1933, when addresses on his life and work were delivered by Professor A. N. Meldrum, Sir Philip Hartog and Sir Harold Hartley. These emphasized his remarkable personality, his nobility of character and the novel contribution to chemical practice arising from his facility in handling gases.

The life of Priestley merits attentive study by all students of science, old and young. He was a genuine philosopher inasmuch as he loved wisdom in all the branches then accessible, and his command of languages was extraordinary. His piety and rectitude were so pronounced and so commingled with curiosity regarding natural phenomena that they invited the persecution of an intolerant age; and it is one of life's ironies that he narrowly escaped destruction on account of his revolutionary sympathies when Lavoisier was beheaded for his counter-revolutionary proclivities. Probably the only years of peace he knew were the concluding decade of his life, spent with his family in Pennsylvania.

Scientific experiments were for him a hobby early adopted and faithfully pursued. His admission that he was "not a practical chemist" in part explains his outstanding success, because, as we are reminded by Dr. Meldrum, he declared that "if I had been accustomed to the usual chemical processes, I should not so easily have thought of any other; and without new modes of operation I should hardly have discovered anything new". His work on gases began in 1767, but he was nearly forty before the experiments with air, and the exact date of his discovering oxygen remains obscure: in fact, the careful survey of correspondence submitted by Sir Philip Hartog to *Nature* (1st July, 1933, p. 25) indicates "before the month of November, 1771" as being probable, the experiments of 1st August, 1774, in Wiltshire and of 1st March 1775, in London, being confirmatory and extensory.

In referring to his outstanding discovery Priestley has modestly recorded a reflection often recurring in the minds and writings of those interested in the relation of cause to effect when he says "it provides a striking illustration of a remark I have more than once made in my philosophical writings and which can hardly be too often repeated, namely, that more is owing to what we call chance than to any proper de ign or preconceived theory in this business". That reflection remains legitimate, but must be accepted only in conjunction with Pasteur's dictum that "in the field of observation chance favours only those who are prepared". M. O. F.

Locomotion of Fishes.

By Dr. Sunder Lal Hora, D.SC., F.R.S.E., F.L.S., F.Z.S., F.A.S.B.,
Zoological Survey of India, Indian Museum, Calcutta.

THE muscular movements of fishes have been studied from a very early time, and the researches of Borelli,[1] Pettigrew,[2] Maurey[3] and Breder[4] deserve special mention in this connection. In spite of the wealth of literature available on the subject (see Breder for bibliography) the exact significance of these movements has only been realized during the current year as a result of the careful work of Dr. J. Gray[5] in the Laboratory of Experimental Zoology, Cambridge. It was believed that the fins of fishes are the main organs of locomotion, and that the fish impels itself forwards by the tail and the caudal fin. These conclusions seem to have been based on erroneous impressions, for the eye observes only the movements of the tail relative to the head instead of observing its motion in relation to the background of the fish. Dr. Gray has, however, recorded photographically the movements of a number of fish against a scaled background, and these records have enabled him to analyse the nature of the part played by different organs in the locomotion of fishes.

Superficially the motions of various types of fish appear to vary considerably from one kind to another. For example, the most conspicuous features of a moving eel are the waves of curvature which pass along the length of the body from head to tail. In the fast-moving mackerel the visible movements appear to be due to transverse strokes executed by the posterior end of the body across the axis of motion. Dr. Gray was able to demonstrate that the waves of muscular contraction occur in almost all fishes, but that these vary greatly in speed of propagation, amplitude and frequency. As in eel, the forward progression of fishes is mainly due to the waves of muscular contraction. It has been experimentally demonstrated by Breder in the case of *Scardineus erythrophthalmus* that it makes no appreciable difference in the "cruising" speed of the fish whether it moves with the caudal fin intact or with the caudal fin carefully amputated. These observations have been confirmed by Gray by the removal of the caudal fins of the rudd, the perch, and the whiting.

In a fish moving forwards the waves of muscular contraction start from the anteriormost region of the body, and it is found that the speed of propagation of the waves is too low to be controlled by the rate of conduction of a simple nervous impulse. The forward propulsion of the fish is due to the fact that its leading surface faces obliquely backwards relative to the head of the fish and that it moves at an angle to its own direction of motion. It is thus seen that so long as the leading surface is moving at an angle to its own path of motion, there will be a pressure exerted at right angles to the surface, and so long as the leading surface is directed obliquely backwards relative to the head of the fish, the pressure will be directed obliquely forwards. "The magnitude of the forward thrust depends, among other things, on (*a*) the angle which the surface of the fish makes with its own path of motion, and (*b*) on the angle between the surface of the fish and the axis of forward movement of the whole fish, (*c*) on the velocity of transverse movements of the body." Dr. Gray has shown that the underlying mechanism of propulsion of a typical fish is similar to that of a typical screw propeller. In this movement it is seen that each point on the body of the fish travels in a horizontal figure of 8 relative to a transverse axis which is moving forwards at the same average velocity as the whole fish.

The rôle of the caudal fin is to offer resistance to the transverse movement of the fish, and in this way it causes the posterior region of the body to lag behind all those parts which lie between itself and the point of contraction. As a result each group of muscles, as it comes into play, operates on a region of the body which is directed obliquely backwards relative to the head. The caudal fin is also responsible for a fairly large percentage of the propulsive thrust, which depends upon the nature of the fin and of the tail.

The directional control of fish movement is also considered by Gray and he finds that "in some cases such changes are effected by movements of the paired fins, but the rapid changes so characteristic of the pelagic types are effected by the muscles of the body itself. In all cases a change in the direction of motion has been found to be due to the propagation of a muscular wave along one side of the body, and the fish always turns towards the side along which the wave is travelling." The turning movement of a fish is divisible into two parts; during the first phase of the movement the head turns through the water by using the tail fin as a fulcrum, while during the second phase the tail moves through the water with the head as a fulcrum. From this it is evident that the amputation of the caudal fin exerts a very far-reaching effect on the turning power of the fish. The caudal fin is thus seen to exert two forces on a moving fish, "(1) it tends to inhibit the transverse movements of the hind end of the body; (2) it exerts a fraction of the forward propulsive thrust."

All the muscle fibres of the trunk as well as of the tail run in a longitudinal direction; their action is so regulated that when a fibre on one side of the body is fully contracted, its corresponding fibre on the other side of the body is fully relaxed. The muscle fibres nearest to the anterior end of the body contract first, and the energy thus generated is transmitted mechanically along the body length of the fish. The transmission of energy takes the form of tension of the stretched skin and muscles of the leading side. As the speed of transmission of the muscular waves is very variable, it seems likely that they are not due to any nervous impulse or disturbance.

Dr. Gray's papers are illustrated with beautiful and instructive plates and a large number of explanatory figures in the text. In a paper to be published shortly in the *Journal of Experimental Biology*, Dr. Gray promises to elucidate further the rôle exerted by the caudal fin during the normal locomotion of the fish. The publication of this paper will, it is hoped, help fully to understand the detailed mechanism of this important organ.

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[2] Pettigrew, J. B., *Animal Locomotion* (London: 1873); "Animal Locomotion; or Walking, Swimming, and Flying, with a dissertation on Aeronautics." *Internat. Sci. Ser., New York*, No. 8, pp. 1-264 (1874).

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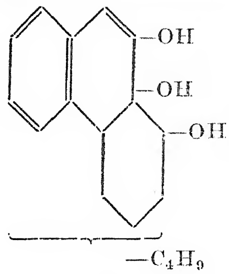
Chemistry of the Œstrogenic Hormones.

THE presence of an active substance in ovarian extracts which produces symptoms typical of normal œstrus in ovariectomised animals was first clearly demonstrated by Marshall and Joly in 1906. It was shown to be fat-like in its solubility and to be highly thermostable. Allen and Doisy in 1923 developed a rapid method for the quantitative assay of the hormone and in 1927 Ascheim and Zondek showed its presence in the urine of pregnant women. Shortly afterwards four different groups of workers, Doisy *et al*, Butenandt, Dingemanse, Laqueur *et al*, and Marrian, isolated independently the crystalline œstrogenic substance from the urine of pregnant women. In an article on the "Recent Progress in the chemistry of the œstrus producing hormone" in *Science Progress* (**28**, 69, 1933) Dr. Marrian discusses the several formulæ suggested for the substance. The work of the different authors mentioned clearly showed the presence of two chemically distinct œstrogenic substances in human pregnancy urine, a hydroxyketone of the formula $C_{18}H_{22}O_2$ and a triol, $C_{18}H_{24}O_3$. Butenandt and Hildebrandt in 1931 converted the triol into the hydroxyketone by dehydration *in vacuo* with potassium bisulphate. Since water was eliminated from the two non-acidic hydroxyl groups of the former, it was assumed that these two hydroxyl groups were attached to adjacent carbon atoms.

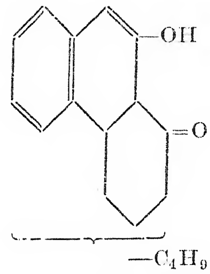
In 1932, Butenandt and Stormer separated two isomers of the hydroxyketone. A number of œstrogenic substances have been since isolated from the urine of mares. It seems likely that there are many closely allied œstrogenic substances yet to be discovered in human and mares' urine.

The work of Butenandt, Thayer, Levin and Doisy showed that besides three aromatic double bonds in the molecule of ketohydroxyœstrin there was another non-aromatic one. Marrian and co-workers showed later that the evidence on which the fourth double bond was postulated was untenable and that there were only three aromatic double bonds in the ketohydroxyœstrin molecule. This was confirmed by Butenandt by hydrogenation experiments.

On the former evidence of four double bonds the following formulæ were suggested for trihydroxyœstrin (I) and for ketohydroxyœstrin (II)

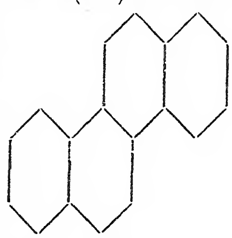


I

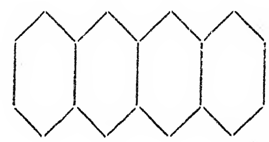


II

But when it was definitely shown that there were only three double bonds, the most probable carbon skeletons were the chrysene (III) or the naphthacene (IV) types.

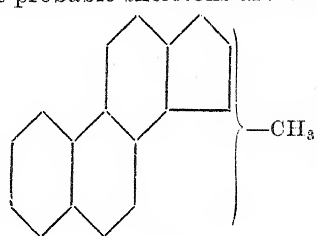


III

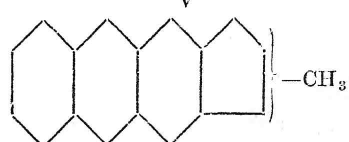


IV

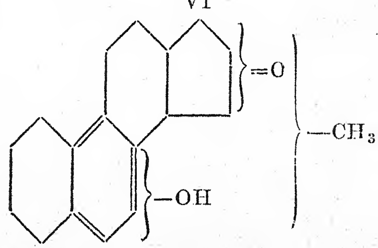
The results of Marrian and Haslewood in 1932, later confirmed by MaCorquodale, Thayer and Doisy in 1933, could be interpreted better on the basis of a five-membered ring than a six membered one. Therefore the most probable skeletons are V and VI



V

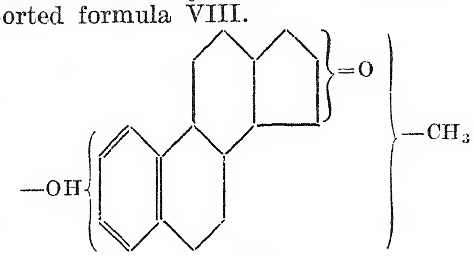


VI



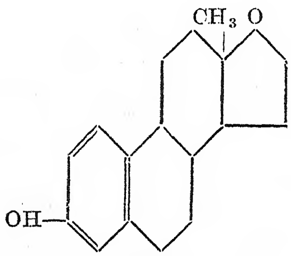
VII

The former authors preferred the skeleton V and postulated VII and VIII as alternatives for ketohydroxyœstrin. Later surface film work by Danielle *et al* clearly supported formula VIII.



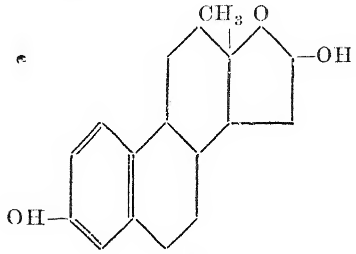
VIII

Simultaneous work on the constitution of sterols and bile acids by Rosenheim and King in 1932 suggested that a modified formula of the type of the chrysene skeleton III would explain the chemical and physical behaviour of the sterols and bile acids better than the old Wieland-Windaus formula. These views were adopted by Wieland and Windaus. This new formula for the sterols suggested the probable relation of the œstrins to the sterols and thus formula VII appeared much more probable. In fact, Butenandt went so far as to suggest IX and X



IX

for ketohydroxy and trihydroxyœstrin respectively. His arguments were criticised by Marrian as speculative but the most recent brilliant researches of Butenandt have proved that œstrins are chemically related to sterols.



X

One of the most remarkable recent developments in this subject is the synthetic work of Cook and Dodds who have produced a large number of œstrogenic substances. Among them are (1) 9 : 10-dihydroxy-9 : 10-di-n-butyl-9 : 10-dihydro-1 : 2 : 5 : 6 dibenzanthracene, (2) 1-keto-1 : 2 : 3 : 4-tetrahydrophenanthrene, (3) 5 : 6-cyclopenteno-1 : 2-benzanthracene, (4) 1 : 2-benzpyrene in descending order of potency. Two of these, *viz.*, 1 : 2 benzpyrene and 5 : 6-cyclopenteno-1 : 2-benzanthracene are also powerful carcinogenic agents. These results have opened a wide field of study. The fact that "the cell prolification which characterises the œstrus state is in some respects reminiscent of the early stages of malignant growth," as stated by Cook and Dodds, suggests that considerable light may be thrown on the whole problem of malignant growths. In view of the established relationship between the œstrins and the sterol group, it will be interesting to hear the results of Cook and Dodds investigations on the carcinogenic activity of 1 : 2-cyclopentenophenanthrene which may be regarded as the basic aromatic hydrocarbon of both the œstrins and sterols.

Letters to the Editor.

Dilatometric Investigations of the Tryptic Digestion of Proteins.

THE kinetics of the tryptic digestion of proteins can be conveniently followed in the two bulb dilatometer (*J. Indian Inst. Sci.*, **15A**, 17, 1932) from the very commencement of the reaction. The hydrolysis is generally accompanied by a considerable contraction in volume which, in the case of casein, amounts to nearly 21·5 c.mm. per gram of material digested in 1 per cent. concentration for 24 hours at 30°C. The volume change is proportional to the release of carboxyl or amino groups (see table and graph I) which are respectively estimated by Willstätter's titration and Van Slyke's gasometric method.

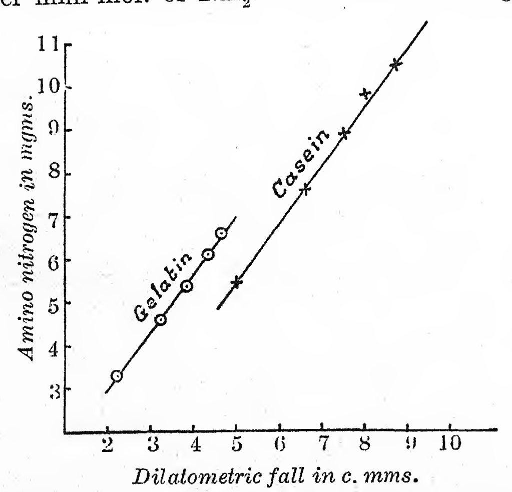
The tryptic hydrolysis of a 1 per cent. casein solution at P_H 7·7 gives a depression of about 12·3 c.mm. per milli mol. of NH_2 released during the hydrolysis, while gelatin under the same set of conditions, gives a contraction of about 9.7 c.mm. per milli mol. of NH_2. The volume change per milli mol. release of NH_2 appears to be characteristic of the structure and amino-acid make up of the protein.

The initial stages of tryptic digestion (during the first 30 mins.) appear to be accompanied by an interesting set of changes which are registered by the dilatometer but are not shown by a corresponding increase either in carboxyl or amino groups. There is, therefore, no linear relationship between the volume change and carboxyl release (see graph II) during the period.

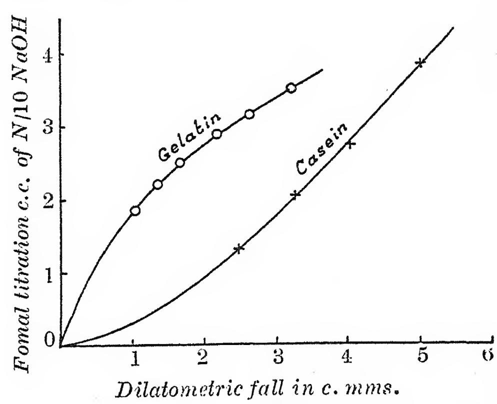
TABLE.

Substrate concentration, 1 per cent.; P_H of reaction mixture 7.7; Concentration of enzyme in reaction mixture, 0.09 per cent.

	Casein				Gelatin			
Time in mins.	30	60	90	120	30	60	90	120
Dilatometric depression in c.mm. ..	4·8	6·6	7·7	8·3	2·2	3·2	3·8	4·3
Amino nitrogen increase in mgms. ..	5·4	7·5	8·7	10·0	3·2	4·6	5·6	6·2



Graph I.



Graph II.

A study of the kinetics of the tryptic digestion of casein and gelatin reveals that casein is split up at approximately double the rate at which gelatin hydrolysis proceeds under comparable conditions. The dilatometer offers a very convenient method of studying the *in vitro* digestibility of various proteins.

By reason of the large change of volume accompanying the hydrolysis, the accuracy attainable by the dilatometric method is much greater than that usually obtained by the chemical methods. As the dilatometric column can be read with an accuracy of 0·5 mm. the error in measurement does not usually exceed 1·5 per cent. while

that involved in Van Slyke analysis is about 4 per cent.

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Bangalore,
July 3, 1933.

The Ground Terms and Ionisation Potential of Br II.

IN the course of investigation of the spark spectra of Bromine,* a careful examination of the plates taken with an amount of inductance just sufficient to elicit the lines of Br II and Br III strongly (while there is considerable suppression of the lines due to higher stages) revealed the following combinations between the deepest 4p ^3P and 5p ^5S, 5p ^3S of Br II.

		5p $^5S_2$	5p $^3S_1$
		6908	
4p $^3P_2$		101529 (20)	108436 (10)
	3058		
$^3P_1$		98470 (15)	105378 (10)
	1251		
$^3P_0$			104127 (10)

Besides the identical behaviour of the five lines under different experimental conditions, the following progression of the interval of the ground term convinces one of the correctness of the identification.

$$mp(^3P_2 - {}^3P_1)$$

O I 158	F II 344	F II/O I	=	2·18
S I 398	Cl II 696	Cl II/S I	=	1·75
Se I 1988	Br II 3058	Br II/Se I	=	1·54

The value of 3058 cm^{-1} obtained for the interval $4p(^3P_2 - {}^3P_1)$ of Br II is thus quite satisfactory. An interesting feature to be noticed is that the intercombination lines 4p ^3P–5s ^5S are much stronger than the triplet–triplet combinations. This feature might be expected as these intercombination lines essentially form what are usually called the resonance lines. It is significant to observe here that the corresponding intercombination lines in the arc spectrum of selenium of the same row of the periodic table have been found in absorption by a column of the non-luminous vapour.†

From the quintet system 5p ^3P–ms ^5S, identified by Bloch, Bloch and Lacroute,‡ it has now been possible to obtain the deepest term 4p $^3P_2$=183280 cm^{-1}, yielding a value of 22·6ν for the second ionisation potential of Bromine. The triplets identified by the above authors seem to be rather uncertain, due to the comparatively low intensity of the combination 5s $^3S_1$–5p $^3P_1$. The author is indebted to Dr. K. R. Rao for placing the plates in the Schuman region, taken with the Siegbahn Vacuum Spectrograph at his disposal.

A. S. RAO.

Department of Physics,
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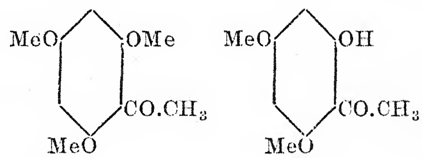
Waltair,
July 3, 1933.

The Action of Aluminium Chloride on Polymethoxyflavones.

A HYDROXYL group in the 5-position in a flavone resembles the *ortho*-hydroxyl in a phenolic ketone in its resistance to methylation under ordinary conditions. It appeared probable that, conversely, a 5-methoxyl of a flavone may be as easy to demethylate as an *ortho*-methoxyl of a ketone. Phloracetophenone trimethyl ether (I) is converted into the dimethyl ether (II)



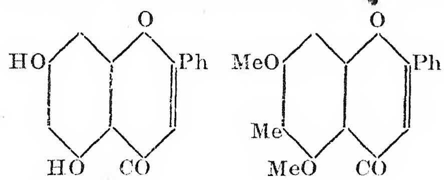
(I) (II)

by heating with aluminium chloride at 110°.§ We have now found that, when a polymethoxyflavone is submitted to the action of aluminium chloride under specified conditions, demethylation takes place only in the 5-position and we are utilizing this observation for the synthesis of naturally occurring, partially methylated polyhydroxyflavones, such as wogonin, rhamnetin and rhamnazin.

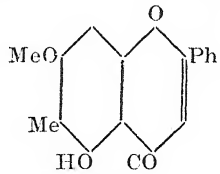
* *Nature*, **131**, 170, 1933.

† Kimura, *Jap. J. Phy.*, p. 81, 1926-27.
‡ *Compt. Rend.*, **193**, 232, 1931.
§ Kostanecki and Tambor, *Ber.*, **32**, 2260, 1899.

The methylation of chrysin (III) in acetone solution with methyl sulphate and alkali yielded a substance whose melting point was different from that of the known dimethyl ether.* The analysis indicated a C-methyl chrysin dimethyl ether (IV) and



(III) (IV)



(V)

treatment with aluminium chloride led to a monomethyl ether (V), closely resembling tectochrysin in its colour reactions.

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G. K. BHARADWAJ.

Technical Chemistry Laboratories,
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Forman Christian College,
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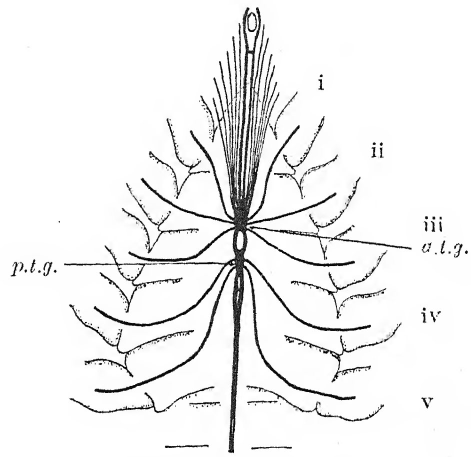
July 6, 1933.

*Tasaki, *Acta Phytochim.*, **2**, 119, 1925.

The Nervous System of Panulirus.

THE thoracic part of the nervous system in the Bombay lobster *Panulirus* has been described in the text-books as a single large ganglion formed by the fusion of eleven pairs of ganglia with an opening in the centre for the sternal artery to pass through. It is thus figured as a ganglionic ring sending out eleven pairs of nerves all-round.

In April last Dr. C. J. George wrote to me from Poona and asked me to see if the ganglionic mass in the thorax was not really two distinct masses. From some dissections which he had occasion to see at Poona he suspected that the description in the text books was not correct. I dissected six specimens collected from Bombay and found that there were two distinct masses of fused ganglia connected together by the double nerve cord, one situated anterior and the other posterior to the descending sternal artery. The anterior thoracic mass gives rise to nine pairs of nerves and is therefore formed of nine pairs of united ganglia, three of the



Panulirus.—Nervous System.
a.t.g. Anterior thoracic ganglion.
p.t.g. Posterior thoracic ganglion.
i-v. Walking legs.

head and six of the thorax, while the posterior thoracic ganglionic mass gives rise to two pairs of nerves and is therefore made up of two pairs of thoracic ganglia. While the individual ganglia could be distinguished in the posterior mass such a clear demarcation is not seen in the anterior mass. A sketch of the system appended illustrates the structure.

M. J. PRESSWALLA.

Department of Biology,
Wilson College,
Bombay,
June 26, 1933.

References :

Powell and Kohiyar, "Lessons in Practical Biology for Indian Students," pp. 129-131 (1926).
Yeolekar and Samarth, "Panulirus or the Spiny Lobster of Bombay," p. 30 (1926).
Mullan, "Animal Types," p. 112 (1929).
Gideon, "An Introduction to Zoology," p. 43 (1930).

Notes on *Ficus indica* Linn., and Closely allied American Species—*Ficus laurifolia* Hort. et. Lam., and *Ficus anthelmintica* Martius.

Ficus glabrata HB & K., as noted in *Nov. Gen. et Sp.* II. 47, is a synonym of *Ficus anthelmintica* Martius. Miquel in Hooker's *Lon. Jour. of Botany* (**1**, 66, 1848) described

it as *Pharmacosycea anthelmintica*, growing as a fine large tree in the primeval forests of the province of Paraensis et Rio Negro in Brazil. Martius mentions about the vermicidal property of the latex of this species. *Ficus laurifolia* Hort., as noted in the *Dict. Ency. Metho. Bot.* Lamarck, (2, 495, 1790) is an American species and is very much allied to *Ficus indica* Linn., which is distributed, as noted in *Flora of British India* (**5**, 506, 1890) in Burma, Perak, Singapore, Andamans and Malay Archipelago. Kurz in his *Forest Flora of British Burma* (**2**, 442, 1877) reports frequent occurrence of *Ficus indica* in the forests from Martaban to Tenasserim. The writer during his recent explorations in these regions confirms Kurz's statement. It extends, as King remarks, up to Philippines. C. E. Parkinson mentions in his *A Forest Flora of the Andaman Islands*, p. 251, 1923, that *Ficus indica* Linn. is "at first epiphytic, often on Padauk or on *Mimusops littoralis*, and eventually forming an independent stem, often of enormous size". When the fruit is ripe in July and August, the tree becomes "the rendezvous of pigeons, minahs and birds of many other kinds".

As regards the systematic position of the two species, *Ficus anthelmintica*, as far as the descriptions go, may be put under the section II as a tree—Urostigma characterised by ♂ and ♀ gall flowers, all in one receptacle (monœcious) borne at the axils of leaves in pairs or rarely solitary with alternate, entire coriaceous or sub-coriaceous leaves. *Ficus indica* and *F. laurifolia* are also under the same section. Lamarck considers *F. laurifolia* as the next species to *F. indica*. None of these species appears to fit in any one of the other six sections of the genus *Ficus*, which is divided into seven broad sections of which Urostigma is the largest. The figures of *F. anthelmintica* and *F. indica* agree quite well. *Ficus laurifolia* again, as noted by Lamarck, is the nearest one to *F. indica* to which, as mentioned by Linneans and quoted by Hooker, includes numerous forms of the plants.

Thus, as far as the literature is concerned, taking into special consideration the monograph on the Indo-Malayan and Chinese *Ficus* by Sir G. King,* I am of opinion that *Ficus indica* Linn. may be considered as the closest species to those of *F. laurifolia* and *F. anthelmintica*. David Prain in his *Bengal Plants* (**2**, 979, 1903) considers Roxburgh's *Ficus indica* Amoen (*Flora Indica*, **3**, 539, 1874) a synonym of *Ficus Bengalensis* Linn. The vermicidal properties of the latex of *F. anthelmintica* indicate that *Ficus indica* may have similar properties. *F. indica* is allied to this species and it may be worth investigating the latex of the Indian species of *F. indica* Linn., or other allied *Ficus* species. The medicinal properties of the juice of *F. indica* are already recognized. "The genus *Ficus* yields a number of economic products. Many species possess a milky juice containing caoutchouc, as *F. elastica* Roxb., of Sumatra, etc. Some of the juices are employed externally as well as internally, as that of *F. indica* L. Some possess anthelmintic properties, as *F. anthelmintica* Mart. Some yield gum lac or shellac as a result of the puncture of an insect, as *F. religiosa* L., *F. laccifera* Roxb.; and some are esteemed for their fruits, as *F. carica* L., *F. religiosa* L., etc."†
Ficus indica Linn. is available in the Royal Botanic Garden, Calcutta, and Botanic Gardens, Singapore.

K. BISWAS.

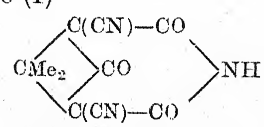
Herbarium,
Royal Botanic Garden,
Calcutta,
July 12, 1933.

*George King, "The species of Ficus of the Indo-Malayan and Chinese Countries", *Annals of the Royal Botanic Garden*, Calcutta, Vol. I (1888).

Experiments on the Synthesis of Pinene: Synthesis of *Cis*-and *Trans*-ketonorpinic Acids.

WORK has been in progress in this department for some time past to obtain pinene synthetically. An intermediate product of very great interest, *viz.*, ketonorpinic acid, has now been obtained, which should facilitate the synthesis of pinene.

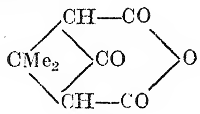
The sodium derivative of Guareschi imide reacts with carbonyl bromide in the cold to yield, among other products, a satisfactory yield of $\alpha\gamma$-dicyano-$\beta\beta$-dimethyl-$\alpha\gamma$-carboglutarimide (I)



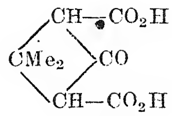
I

†*The Dispensatory of the United States of America*, p. 1394 (1908).

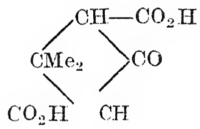
This on treatment with sulphuric acid at 105° for five hours gives the anhydride (II) and the *cis*-form of ketonorpinic acid (III), whereas, at 130° the *trans*-variety (IV) is obtained.



II

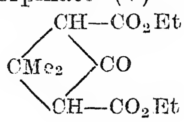


III



IV

The sodium derivative of ethyl acetone-dicarboxylate in benzene suspension reacts with chloracetol when heated in a sealed vessel at high temperature to yield the diethyl ketonorpinate (V)



V

Constitution of this ester has been established by its conversion into the dicarboxylic acid (III) on hydrolysis with baryta.

This ester (V) with two active methylene groups in 1 : 3 positions should form a convenient starting material for the synthesis of pinene and allied products.

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R. C. DAS GUPTA.

Department of Organic Chemistry,
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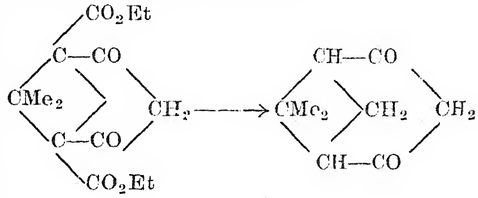
Bangalore,
July 31, 1933.

A New Method of Synthesis of Bicyclic Compounds.

THE attempts made by Guha and Patel (*J. Indian Inst. Sc.*, **15A**, 125, 1932) to effect bridge formation between the 1 : 4 carbon atoms in *cyclo*hexane-2 : 3-dione-1 : 4-dicarboxylic ester and by Guha and Mayuranathan (*Ibid.*, p. 131), between the 1 : 3 carbon atoms of Scheiber and Miesel's ester according to the conditions then employed were not successful.

We have now succeeded by a thorough modification of the experimental methods in effecting the desired bridge formations. The disodium derivative of Scheiber and Miesel's ester in benzene suspension reacts with methylene iodide when heated in a closed vessel at a high temperature to form the bridged ester (I) which on hydrolysis gives ketonopinone (II).



I II

Succinosuccinic ester under similar conditions yields the 1 : 4-bridged compound.

This novel method has wide possibilities of application to the synthesis of bicyclic compounds in the terpene class.

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K. N. GAIND.
D. R. MEHTA.

Department of Organic Chemistry,
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Bangalore,
July 31, 1933.

Studies on the Life-History of *Limnophyton obtusifolium* (Miquel).

THE short note published by Mr. B. M. Johri in *Current Science*, 2, 12, 1933, on the morphology of *L. obtusifolium* contains certain observations which differ fundamentally from those which I have been able to gather from my studies on the same plant. There does not appear to be any discrepancy regarding the identification of the material and therefore it is necessary for me to briefly mention here the points of difference.

1. *Embryo sac.*—Mr. Johri has described the embryo sac as possessing only six nuclei. In my studies I have come across embryo sacs containing all the eight nuclei in the early stages (Figs. 1 & 2). Probably the observations of Mr. Johri have been based upon the examination of fully organized embryo sacs where two of the antipodal nuclei have already degenerated. I may further add that the synergids possess a 'filiform apparatus'.

2. *Tapetum.*—In my preparations I find that the tapetum is parietal in origin and that there are no middle layers while Mr. Johri has described the sporogenous origin of the tapetum and the occurrence of middle layers. In later stages the tapetal cells are found to be wandering amidst the

developing pollen grains and they do not coalesce to form a true periplasmodium.

3. *Pollen grain.*—The mature pollen grain possesses, besides the tube nucleus, two distinct male cells which can be clearly made out by a distinct cytoplasmic sheath surrounding each male nucleus. This cytoplasmic sheath is quite different in appearance from the general cytoplasm of the pollen grain (Fig. 3). Therefore they are not mere male nuclei as has been described by Mr. Johri.

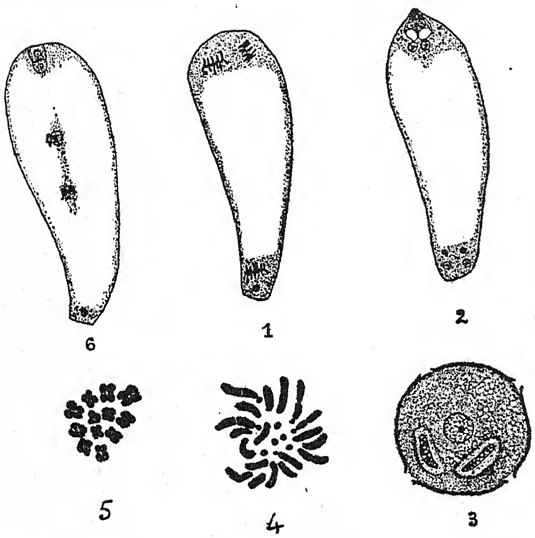

Fig. 1. × 660 app. Mitotic divisions in the embryo-sac; one of the nuclei at the chalazal end still undivided.

Fig. 2. × 900 app. Eight-nucleate embryo-sac which is not yet fully organised.

Fig. 3. × 900 app. A ripe pollen grain with a tube nucleus and two male cells.

Fig. 4. × 1,800. Polar view of the early anaphase of mitosis showing 24 chromosomes (diploid number). Satellites seen on 5 of them.

Fig. 5. × 1,800. Polar view of heterotypic metaphase showing 12 bivalents (haploid number).

Fig. 6. × 660 app. Abnormal polar fusion; each polar nucleus being fertilised by a generative nucleus.

Besides the above my detailed studies of the same plant both from cytological and morphological aspects have revealed the following interesting results :—

The chromosome number as determined both from the haploid and diploid generations is found to be 12 and 24 respectively (Figs. 5 & 4). The study of the somatic mitosis shows the origin and behaviour of the 'chromonema structure' of the chromosomes and the occurrence of constrictions and trabants (satellites) on the chromosomes (Fig. 4). The longitudinal split in the chromosome is found to take place in late prophase just before the arrangement of the chromosomes on the metaphase plate.

An abnormal case of fertilisation was noticed in which one of the generative nuclei was observed to fragment into two and each of them fused independently with the two polar nuclei (Fig. 6).

Regarding the embryogeny, the first longitudinal wall appears when the proembryo is five-celled. The fully formed embryo is horse-shoe shaped with practically no endosperm surrounding it.

I wish to express my deep sense of gratitude to Dr. M. A. Sampathkumaran, Professor of Botany, Central College, Bangalore, under whose guidance the work was carried out.

S. K. NARASIMHA MURTHI.

Department of Botany,
University of Mysore,
Bangalore,
August 1933.

Hydro-Electric Schemes in India.

IN the interesting note on hydro-electric schemes in India published in the July issue of *Current Science*, the author has omitted to draw attention to one feature—the electrical isolation of Mysore. With the development of systems on the North, South and West, all employing 50 cycles, Mysore with its 25 cycles may eventually become an island cut off from all co-operation with its neighbours. With the example of England before us and a knowledge of the vast sums recently expended in frequency standardization, should we not consider what can be done to save the situation ?

It may be argued that the case of England and of India is not the same and that Mysore is large enough to be self-contained. To take a few instances, however, what would be the position in the event of general railway electrification ? It is already almost impossible to purchase standard wireless apparatus for use on 25 cycle mains, may not this apply to electrical machinery in general before many years have elapsed ? What is the effect of 25 cycle illumination on the eyesight of villagers ? Any electrical engineer could add many more arguments of a technical nature and if the whole question is considered it seems almost certain that sooner or later conversion is bound to come.

On the other hand, we are told that this step is impossible on the ground of cost. One thing is certain, however, and that is, that the longer the matter is delayed the greater will be the cost. In spite of the cry "financial stringency", the present time is most opportune; machinery is cheap, and money, in the event of a loan being necessary, is also cheap. It is not for a layman to discuss details, but it appears to me that with a carefully planned progressive scheme, the expenditure might not be as great as appears likely at first sight. The Kolar load which is more than half the total must be regarded as temporary and might well be left alone. All new extensions might be supplied with frequency changers (and admittedly run at a loss for a while) and the change-over extended backwards until the cities of Bangalore and Mysore were reached. At this point the conversion would have to be a wholesale one both at the generating station and consumers' premises, but the power involved is comparatively small and there should be no great technical difficulty. It would be interesting to have the opinion of experts on this subject.

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Indian Institute of Science,
Bangalore,
August 1933.

Disappearance of Colonies from Count Media.

THIS phenomenon was first reported by Subrahmanyan and Ganesha Rao (*J. Indian Inst. Sci.*, **12A**, 253, 1929) in the case of soil bacteria and confirmed independently by Corbet (*J. Rubber Research Inst., Malaya*, **3**, 7, 1931). Its nature and significance have so far remained obscure.

Quantitative studies of a number of soils and on a variety of biological media have shown the following:—(1) Colonies disappear from all the count media that have so far been devised. (2) The numbers that disappear vary with different soils and are, in some cases, as high as 15 per cent. of the final counts. (3) The colonies first appear in the early stages of incubation, generally within the first 3 days. In a short time they turn first translucent, then increasingly faint until they fade out altogether at the end of about a week. (4) It has not, so far, been possible to cultivate the disappearing organisms owing to the fact that they generally die out before the fading of the colonies can be observed.

Further study of the phenomenon is in progress to determine its significance in relation to (*a*) the accuracy of the present methods of enumerating different soil micro-organisms, and (*b*) disintegration of microbial cells resulting in their ultimate transformation into plant nutrients.

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Bangalore,
July 8, 1933.

A Note on Cyst-Formation in *Protosiphon botryoides* (Kutz.) Klebs.

THIS alga was collected from Bodal, District Hoshiarpur, Panjab, where it appeared in great abundance in fields lying fallow after the rains in October 1929. Patches of soil, often many yards in diameter, appeared like bright green carpets from a distance. The alga has a globular aerial portion with

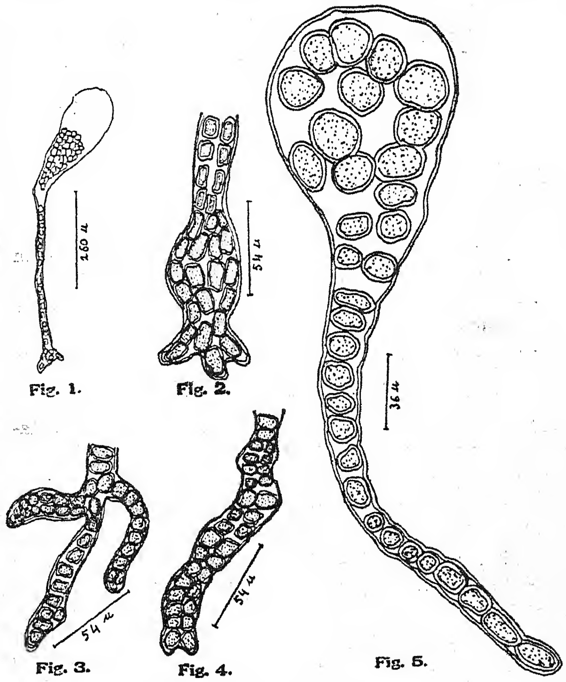

Fig. 1. An adult plant with cysts.
Fig. 2. A slightly branching rhizoid with swelling near the dichotomy.
Fig. 3. A clearly branching rhizoid.
Fig. 4. Biseriate cysts.
Fig. 5. A plant with mature cysts.

reticulate chloroplasts and numerous pyrenoids. The average size of the vesicle is about 130μ. The rhizoidal part is usually unbranched but in some cases it shows a clear dichotomy at the lower portion (Figs. 1–3).

A peculiar type of cyst-formation was observed in this alga. The process takes place simultaneously in the rhizoidal and aerial portions, the protoplasm being divided profusely into a number of rounded pieces and extensive wall-formation taking place. The result is the production of a number of red cysts, 18–20μ in diameter and with granular contents and thick lamellated walls (Fig. 5) which are very different from those figured by Oltmanns (Oltmanns 1904, p. 178, fig. 110) and Brunnthaler (Brunnthaler 1915, p. 87, fig. 45). In some cases the whole of the globular aerial portion is filled with cysts, and usually the cysts occur in a single row in the rhizoidal portion (Fig. 5), but two or even three irregular rows of cysts in this part are not uncommon (Figs. 2 & 4). The cysts are rounded in the aerial portion and rectangular in the rhizoidal portion due to compression of the rhizoidal walls. Very often the lower portion of certain rhizoids becomes distinctly swollen and has 3–4 series of cysts inside (Fig. 3). The peculiarity in cyst-formation, therefore, consists in the occasional multiseriate nature of the cysts, which is sometimes accompanied by a clear swelling near the dichotomy.

S. L. GHOSE.
M. S. RANDHAWA.

Department of Botany,
University of the Panjab, Lahore,
July 5, 1933.

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The Glacier.

I am born on the height, in the wintry night,
  Of my misty mother the Cloud;
Wooed by the Earth, she dies giving birth,
  And I, like a living shroud,

Spread my white form and am tossed by the
  Against the breast of my sire; [storm
While the thunder groans, and the whirlwind
  And the lightning flashes fire. [moans,

Soft and white, like a new-born sprite,
  My infant way I grope,
Aimless and free—my road to the sea
  No more than a hazard of slope:

For a shoulder of rock, or haply a block,
  May govern the path of my motion;
A spur may frown and send me down
  On my way to a different ocean.

Chased by the Wind, I hide behind
  Some sheltering boss or hollow,
And laugh to spy him blundering by,
  Safe that he cannot follow.

With a sudden sweep I plunge down the
  And then the mighty hush [steep,
Of slumbering crag and pinnacled jag
  Is rent by my thunderous rush.

From islets serene and dells of green
  The Gentian and Alpine Rose
Open their eyes in smiling surprise
  At the depth of my chilly snows.

I harden and grow, as I pass below
  With my burden of fallen blocks,
Which, seized in the vice of my sinews of ice,
  Chisel my bed in the rocks.

Circling around the hummocky ground,
  I am sprawling half-asleep;
Or over the edge of a dizzy ledge,
  Reckless, I madly leap.

And wherever a crack has rent my back,
  From my crystal deeps are wrung
Soft shadows new and shafts as blue
  As the sky from which I sprung.

When the breathless spell of the flaming
  Of dead Day fades before me, [farewell
As she follows his hearse, Night stoops like
  To fling her mantle o'er me. [a nurse

But the Moon will arise and steal from the
  To pluck the mantle aside, [skies
And awake with the blaze of her silver rays
  The glory my crevices hide.

And when she retires with her dulcet fires,
  The sombre dark I leaven,
Reflecting sweet bars of light from the stars
  That bejewel the bowl of Heaven.

The morning Sun wakes me to fun,
  As he pierces the Earth's blue rafter;
I flash in my strength, but dissolve at length
  Into streams of gurgling laughter.

E. H. P.

The Industrial Outlook.

Industrialising India.*

WE had occasion to review in our columns[1] the thoughtful contribution of Sir M. Visvesvaraya to the problem of Unemployment in India. The present publication is a continuation of the above with some definite suggestions regarding the lines of action to be taken by the Government and others interested in the industrial development of the country. In his introductory remarks the author lays stress on the fact that industrialisation will be the sole means of relieving the increasing unemployment, raising the status of the people and restoring the prosperity of the country. Although agriculture is the basic industry of the human race, yet it has always been a precarious means of livelihood, so that if the country is to prosper the pressure on the land should be reduced without impairing the efficiency of agricultural production. The Government as well as the members of the public should direct their attention to the development of industries, which alone would contribute materially to the prosperity of the country.

In recent years, the Indian export of finished articles has greatly diminished while imports of similar materials from abroad has considerably increased. The small favourable trade balance, which is also steadily diminishing, is largely due to increase in the exports of raw materials, a position which, in the eyes of experienced critics, is not likely to be maintained very long. Various parts of the world, hitherto undeveloped, are now producing increasing quantities of grains and food articles, so that, before long, we may be faced with a situation in which we will be the exporters of neither raw materials nor finished articles.

After classifying the possible new industries under three main heads—large, medium and small[2]—the author proceeds to discuss the nature of the structure that is immediately needed for their development. There should be (1) a general organisation composed of representatives of Government and business men who, by mutual co-operation, would maintain the atmosphere favourable to the rapid growth of industries, (2) local organisations such as councils in cities and rural areas for promoting industries suited for the particular localities, (3) adequate tariff protection for such industries as need them, (4) banking facilities, (5) provision of statistical information, and (6) proper legislation regarding the Companies Act and managing agency system so that the public may develop confidence and business will attract the necessary capital. The industrial sense of the country may be further developed by holding exhibitions and organising commercial museums and demonstration stations, encouraging industrial research, imparting technical education and arranging for easy transport facilities.

The present conditions in India are highly discouraging. Millions of people in rural areas live in abject poverty and tens of thousands of graduates and educated men roam about the country in search of employment. The only possible way of maintaining the rapidly increasing millions of India in a moderate state of comfort is to adopt a policy of rapid industrialisation. The programme of development during the next few years has to be carefully planned and energetically carried out. If left to the chances of natural growth under existing abnormal conditions it is impossible to expect any real progress. It is, therefore, absolutely necessary for those in authority to adopt immediate and effective measures for checking the present drift towards ruralisation and take steps to attract the best talents of the country—which are rusting through neglect—to work out a scheme of industrial development.

The country owes a deep debt of gratitude to the veteran statesman who, in spite of his declining years, is still one of the foremost in the cause of public service. Sir Visvesvaraya has no doubt given much thought to the details of many of the industries that he has referred to in the course of his several public addresses and it will be highly stimulating both to those engaged in the promotion of industries and to the members of the public if he could further develop some of his themes and show precisely how certain specific industries can be safely

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* *Industrialising India: Constructive Policies and Plan*, by Sir M. Visvesvaraya, K.C.I.E., LL.D. An address delivered before the Mysore Chamber of Commerce on the 10th July 1933. The Bangalore Press, Bangalore. Price As. 12.

[1] "Unemployment in India," *Curr. Sci.*, **1**, 93, 1932.

[2] *Vide Curr. Sci.*, **1**, 95, 1932.

developed in certain parts of the country. Attention may also be drawn to the fact that side by side with the development of new industries, the produce from land should also be increased. We may even venture to suggest that the new industries are more likely to succeed if they involve the utilisation of surplus agricultural produce—wherein there is yet no danger of foreign competition—and cheap labour, which is plentifully available, rather than if they require the importance of either raw materials or expensive machinery from abroad.

The Future of the Sugar Industry.

IT is rather unfortunate that the Conference held recently* at Simla did not lead to any definition of policy that would materially help the cause of the sugar industry in the country. There was ample scope for the free exchange of views, but the delegates could not arrive at any unanimous decision regarding any one of the items on the agenda. The Central Government, quite wisely, sought the necessary guidance from the experience of the Provincial representatives, but the latter were unfortunately so circumscribed that they could not view the problem as an all-India question. The Conference thus ended the delegates parting with the satisfaction that they had an opportunity to understand each other's views and plans.

The Conference was convened by the Government of India to consider whether (1) the present rate of development of the sugar industry is satisfactory, (2) the protection has unduly benefited the manufacturers at the expense of the consumers, (3) the benefits of protection are being adequately distributed between the cane growers and the sugar manufacturers, (4) the interests of the industry will be best served by zoning of areas, licensing factories, fixation of cane prices or other means, and (5) any legislation is needed to regulate the Indian sugar industry and, if so, to what extent the necessary action should be taken by the Central or the Provincial Governments.

The proceedings of the Conference may be summed up as follows:—The chairman (Mian Sir Fazl-i-Hussain) welcomed the delegates in a short and felicitous speech and placed the problems at issue before the meeting. The discussion on the present position of the sugar industry elicited diverse opinions, the provinces which had already made some headway viewing further expansion with disfavour while the others, less fortunate, pleaded for the erection of more factories. A resolution expressing satisfaction with the present progress and viewing further production of white sugar as being detrimental to the interests of raw sugar (*gur*) manufacture was passed by a majority, but was rescinded at a later stage. Considerable amount of time was devoted to the discussion as to whether any legislation was needed to regulate the nature of the relation between the growers and the manufacturers. Some of the provinces were for the zoning of the areas and regulation of the cane prices while the others were either opposed to such an arrangement or had no experience of the problem. A small committee was appointed to go into the question, but their findings were ignored as a 'private report', so that although the United Provinces is already faced with the difficult problem of having to adjust the relation between over thirty factories and the growers, no useful line of action could be agreed upon. Some time was devoted to a discussion of the problem of utilisation of molasses, but a resolution sponsored by twenty members requesting that (*a*) sugar manufacturers be permitted to produce power alcohol from waste molasses and sell it for use in India and abroad, and (*b*) petrol companies in India be made to sell liquid fuel containing 30 per cent alcohol was disallowed by the chairman. The Conference thus terminated having reached no decision regarding any of the points at issue.

It is indeed regrettable that the Conference could not view the problems in their proper perspective and arrive at decisions which would not only ease the present situation but also avert possible difficulties which would arise in the future when the protective tariff is withdrawn. Any one interested in the stabilisation of a prosperous sugar industry in the country should take the following facts into consideration:—(1) All provinces of the country are not equally well adapted for growing sugarcane in an intensive manner that would facilitate a large-scale production of the sugar at rates that would defy competition from other parts of the world. (2) In certain parts of the country, particularly in regions which are far away from the coast and situated at considerable distances from the

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* 10th to 12th July 1933.

more intense sugarcane areas, it may still be possible to produce sugar at competitive rates owing to the heavy cost of transit from one part of the country to the other. (3) In all civilised countries the consumption of sugar per head of population has greatly increased during the past few decades. It is not improbable, therefore, that with a more liberal supply of sugar and with increasing general prosperity, the Indian consumption may become doubled or even trebled during the next half century. (4) Although raw sugar has certain good qualities and appeals to a particular type of palate, yet even in orthodox circles it is now being steadily displaced by the cleaner and better-keeping white sugar. The sentiment against the use of bone charcoal is steadily weakening and with the introduction of new and more active types of charcoals of vegetable origin even the little objection which now exists against white sugar will soon disappear. (5) The process of refining raw sugar is at present somewhat expensive and wasteful, but with improvement in the technique it should be possible to convert it into a paying industry. In other words, even in localities where cane growing is somewhat scattered it may soon be possible to collect all the raw sugar and convert it into the white, crystalline product. (6) The problem of utilisation of molasses is already assuming serious proportions. Unless some new use such as conversion into crystalline sugar or edible sugar syrups is developed, manufacture of power alcohol would be the only satisfactory method of utilising the large quantities that would be turned out every year by the numerous sugar factories in the country.

Reviewing the present position in the light of the above facts, it would be seen that the cultivation of sugarcane, as also the manufacture of white sugar, will always be more intense and more paying in certain parts of the country (*e.g.*, a large stretch of the Indo-Gangetic plain) than in others. There are also fairly big patches in other parts of the country where sugar can always be produced on a competitive basis. Some of these areas are situated far inland (*e.g.*, Mysore), so that with the additional protection imposed by the high cost of transit they could always defy foreign or other internal competition. It should, at the same time, be admitted that there are several other tracts in the country where cane is now being grown and factories are either already operating or on the point of doing so, where the industry will either not pay or will bring in a useful return only so long as the present protective tariff prevails. It would follow, therefore, that the Central and the Provincial Governments should actively co-operate in encouraging areas where the conditions will always be favourable for profitable manufacture of sugar and discourage others where the investors are eventually likely to fail. It is no doubt true that it will be difficult to arrive at correct estimates of the cost of production of sugar in different parts of the country and the possible extent to which they could eventually compete on the basis of free trade, but judging from the average yield of cane and the general factory conditions, it should be possible for a competent committee of experts to arrive at useful working estimates for different localities which would serve for the guidance of the Government or the information of the public. The success of several North Indian factories has inspired a certain amount of confidence in the sugar industry and large amount of capital is flowing unreservedly even into areas where the industry will not pay. The public should, therefore, be given the necessary authentic information so that they would be properly guided in their investments on new ventures.

The future of white sugar in relation to *gur* will largely be determined by public taste. There is already evidence of increasing favour for the white sugar and if the conditions prevailing in certain Western countries like Great Britain could be taken as the standard, one may reasonably expect that white sugar will soon almost entirely displace the raw product.

With regard to the total consumption of sugar, the experience of different parts of the world would point to its being definitely on the increase. India could be no exception to the rapidly developing "sweet tooth" so that this tendency combined with the possible preference for the white sugar will hold out a highly hopeful future for the sugar industry.

It is no doubt true that a pampered and well-protected industry may (*sic*) take its own terms both to the growers and to the consumers. With a view to ensuring fair deal to the latter, the Central and the Provincial Governments can maintain competent standing committees that can determine (*a*) the minimum price to be paid to cane in each locality, and (*b*) the maximum

price that should be paid by the consumer in any part of the country. At the same time, with a view to reducing the risk of excessive internal competition, the Central Government may legislate offering a useful bounty on sugar exported abroad. In this manner not only will there be fair deal all round but by the adoption of a watchful policy the Government will also be stabilising an industry which the protective tariff has now helped to create. At their end the manufacturers should also organise their efforts both for increasing the popularity of sugar as an article of food and for establishing a useful export trade.

It has already been mentioned that the process of sugar refining as at present practised, is not paying except for the manufacturer of sugar of the highest type of purity for which there is only a limited demand. Since the establishment of refineries will be the only workable means of manufacturing white sugar in certain parts of the country where cane is scattered, it may therefore be necessary to initiate researches with a view to simplifying the process of refining so that raw sugar can be converted into white product at moderate cost. The Central Government should encourage the necessary scientific investigations by subsidising them and offering attractive prizes for new and workable methods.

The problem of utilisation of molasses is engaging the attention of scientists all over the world, but so far only the manufacture of power alcohol has proved to be the most satisfactory method of converting that by-product into an article of commerce. The fermentation of molasses to alcohol is now a fairly well standardised process and yields of about 90 per cent. of the theoretical amount of alcohol may be reasonably expected from well-managed distilleries. Two essential points for success of the manufacture are that the process should be continuous and that the energy spent on the distillation of alcohol should be reduced to a minimum. There are now a few good types of fermenting and distilling plants on the market and with proper technical control it should be possible to make the process a success. Alcohol of nearly absolute purity is miscible with petrol in all proportions and, as suggested by several of the representatives at the recent Conference, all internal combustion engines designed to run on pure petrol can work, with at least the same efficiency, on liquid fuel containing 30 per cent. of alcohol and 70 of petrol. In addition to the above, alcohol is the basic material for a number of chemical manufactures and pharmaceutical preparations, so that, with an abundant supply of cheap alcohol, there will be a great stimulus to various other industries in the country.

It should be admitted, however, that the excise control of the manufacture of alcohol by private factories is highly difficult. It may, therefore, be suggested that the manufacture of alcohol from molasses be established as a separate industry managed or adequately supervised by the State. The distilling company can then buy the molasses at scheduled rates from the sugar factories in the neighbourhood and manufacture the alcohol. The size of the fermenting and the distilling plants would depend on the amount of molasses available in the district. The alcohol thus produced can, at any rate for the present, be distributed directly under State supervision. Admixture with petrol may be carried out at the big provincial stores and the new liquid fuel supplied as such, to the retail dealers who, in turn, will sell it to the consumers. In this manner, both the misuse of alcohol as such and the possible further adulteration of petrol with alcohol can be avoided.

It is not improbable that there may be a certain amount of misgiving in the minds of the petrol manufacturers that the consumption of their product will be reduced to the extent to which alcohol is added. But such need not necessarily be the case. The abundant supply of cheap fuel will in fact stimulate increased consumption of the new petrol by automobiles and as also various industries. Moreover, petroleum has several valuable properties which could not be easily displaced by alcohol so that there is no need to apprehend the future of the oil mining industry.

Other possible uses of molasses would relate to either its conversion to clean sugar syrup, manufacture of animal feeds or utilisation as manure for sugarcane and other crops as is now being done in other countries. It is no doubt true that molasses contains the major part of the minerals taken up by the cane during its life, but the sugar present along with it will be largely wasted in the soil. It is possible that under highly favourable conditions the molasses will help the soil to fix the nitrogen of the atmosphere, but, more often than not,

injudicious application of molasses either as such or with diluted water to the soil would lead to profuse growth of fungi, which would not only lead to soil sickness but also perhaps attack the cane growing thereon.

In the foregoing columns we have only outlined some of the more important problems that now face the sugar industry in the country. Factories are springing up everywhere at a rapid rate and it is not unlikely that, before long, some of the problems may become highly acute. It is suggested, therefore, that while conditions are still favourable the Government should take the initiative in the matter and appoint a competent committee to go into the above and related problems and advise them with regard to the best means of dealing with them. It is not too much to hope that by the adoption of such a wise and far-sighted policy, India will not only have stable sugar industry of her own, but will also, before long, be one of the foremost sugar exporting countries of the World.

Research Notes.

Peach Yellows and Sandal Spike.

IN a recent paper (*Contrib. Boyce Thompson Ins.*, **5**, 19, 1933) Dr. L. O. Kunkel shows that peach yellows is transmitted by the leafhopper *Macropsis trimaculata*, and not by several other suctorial insects with which transmission experiments were tried. The obvious inference is that *M. trimaculata* is the specific vector of peach yellows.

This result is of considerable interest as the vector of this virus disease, like that of sandal spike, has eluded prolonged investigation. Moreover, with sandal spike, peach yellows was at one time regarded as being due to unbalanced sap circulation, a theory which continued in certain quarters because the vectors of these diseases were unknown. The case of peach yellows has also been cited as an argument against the hypothesis (Dover, *Ind. For. Rec.*, **17**, 1, 1932) that sandal spike is transmitted by a specific suctorial vector belonging to the Jassidæ, in which group the vectors of other yellows diseases, such as Aster yellows, are included. It was said that "The fact that other diseases are carried by sap-sucking insects does not form a sound argument for extending the analogy to spike-disease. There are several diseases of the virus group, in fact, which have not been transmitted by sucking insects. Peach yellows and peach rosette are typical instances in point." According to Quanjer (*Phytopathology*, **21**, 577, 1931), however, the yellows diseases are characterized by the fact that they are transmitted only by grafting and by specific suctorial vectors (never by mechanical sap inoculation), peach yellows and sandal spike being regarded as exceptions to the rule, as they had been transmitted by grafting but not by insects. Dr. Kunkel's work, therefore, not only definitely identifies peach yellows with the other yellows diseases, but provides indirect support for the contention that a specific suctorial vector is also responsible for the transmission of sandal spike, the remaining exception in the yellows group of viroses.

The success which has attended Dr. Kunkel's studies on peach yellows, and his work on other yellows diseases, should provide much encouragement and inspiration for those engaged on the problem of sandal spike. Patience and a critical attack have conquered the most elusive problems offered by virus diseases, and there is every reason to suppose that the sandal spike problem is susceptible to the same approach. In fact the information already available suggests that it will not be long before the cause of sandal spike is positively determined.

CEDRIC DOVER.

The Origin of Granite Magmas.

THE recent paper by P. Eskola (*Miner. und Petrogr. Mitteil*, **12**, Nos. 5 and 6, 1932) forms an important contribution towards the solution of the controversial problem of the origin of granitic magmas. From his intimate knowledge of pre-Cambrian massifs, he discusses the possibility of reconciling the two apparently opposed facts—"the downward increase in the amount of granite in the upper parts of the earth's crust and the downward increase of basicity in the globe as a whole." His conclusions may be briefly summarised as follows: "(1) The sial crust (*a*) originated mainly by crystallization-differentiation allied with partial

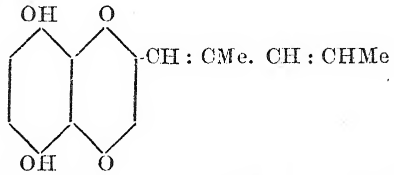
(selective) re-fusion and squeezing out of substance from older rocks and (*b*) has gradually thickened during geological ages. (2) The downward increase in the amount of granite is due to its magma-tectonic origin—the magma originating in the roots of orogens and for the most part, solidifying there; whereas the reduced amount of granite near surface is due to the rise of basic material into the upper zones of the orogens, and to large-scale intrusions of basic lava in the kratogens." Eskola does not believe that a granite could originate from a basic silicate magma like that of plateau basalt by a process of crystallization-differentiation, as suggested by Holmes. Eskola's considered opinion on the problem of the origin of magmas is that "in the formation of the Earth's lithosphere, differentiation (preferentially by the squeezing out of fluid from crystal mesh) was most effective in the earliest stages, whereas palingenesis may have played a more important rôle during the later orogenic periods."

A New Constitutional Formula for Alkannin.

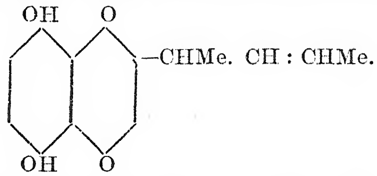
ALTHOUGH attempts have been made since 1833 to study the composition and constitution of alkannin—the important colouring principle of alkanet root—sufficient reliable data which would indicate to a correct formula are yet wanting. Its composition has been given by various investigators, as $C_{17}H_{10}O_4$, $C_{35}H_{20}O_8$, $C_{15}H_{15}O_4$, $C_{15}H_{12}O_4$ and $C_{30}H_{28}O_8$.

M. V. Betrabet and G. C. Chakravarti (*Proc. Ind. Sci. Cong.*, 1930, p. 181; 1931, p. 166; *J. Indian Inst. Sci.*, **16A**, pt. 4, 41, 1933) have suggested a new formula for alkannin. Unlike the previous workers, they subjected alkannin to an exhaustive purification through its acetyl derivative and gave $C_{15}H_{13}O_4$ as the empirical formula. Molecular weight determinations showed that the actual formula was double that of the empirical one and was $C_{30}H_{26}O_8$. The formation of a tetra-acetyl-, tetra-benzoyl-, dimethoxy-, dimethoxy-dibenzoyl-, and dicarbethoxy-, derivatives showed definitely the presence of four hydroxyl groups —two phenolic and two alcoholic. Oxidation experiments yielded oxalic and succinic acids along with two nitro-compounds and a neutral body. Distillation with zinc dust gave β-methyl-anthracene.

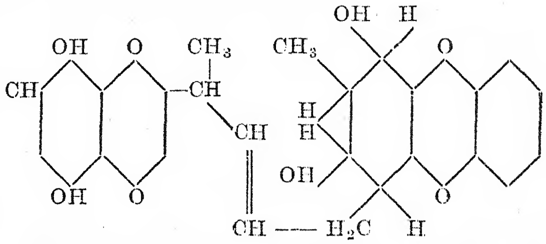
From the molecular weight of a tetra-acetylleuco-alkannin and from the formation of naphthazarin on distillation of alkannin *in vacuo*, Raudnitz, Redlich and Fiedler (*Ber.*, **64**, 1835, 1931; *cf.* Raudnitz, *ibid.*, **65**, 159, 1932 suggested $C_{16}H_{14}O_4$ as the molecular formula having the following constitution:



Dieterle, Salomon and Nosseck (*Ibid.*, **64**, 2086, 1931) ozonised alkannin in chloroform and got a dihydroxynaphthaquinone-dicarboxylic acid. They assigned $C_{15}H_{14}O_4$ as the formula with the following structure:



Betrabet and Chakravarti (*loc. cit.*) have correlated the whole data and suggested the following constitution:



Big as the molecule is, it is very difficult to say that this is *the* constitution. A larger number of degradation products have to be studied. The authors say that further experiments on these lines are in progress. The results of these investigations should be very welcome to "structural chemists".

Anisotropies in Paramagnetic Crystals.

IN continuation of the work briefly described in a previous issue of this Journal (*Curr. Sci.*, **1**, 239, 1933) Krishnan, Chakravarty and Banerjee have extended their investigation to paramagnetic crystals, and in *Phil. Trans. Roy. Soc.*, **A 232**, 99, 1933, they give a detailed report of the results of measurement on a large number of paramagnetic sulphates and double sulphates. The measurements seek to remove the discrepancies between various observers. The work of Jackson

(*Phil. Trans.*, **224**, 1, 1924; **226**, 107, 1927) is discussed in detail and some errors introduced by neglecting the signs of the couples acting on the crystal cylinders employed by Jackson are corrected. Details of the method employed by the authors are given; in the main the method is similar to that used by them in the case of diamagnetic crystals. A comparison of their results with those of others is also given. Among the crystals studied manganese ammonium sulphate was found to have the smallest anisotropy; the smallness of anisotropy is in agreement with what is to be expected from theory. Further work on the variation of the susceptibilities of some of the crystals at low temperatures is also reported to be in progress.

Unit Characters in Fossils.

IN a recent number of the *Proceedings of the Cambridge Philosophical Society*, **7**, 4, 1933, H. H. Swinnerton has published a paper on what he calls the "unit characters" in fossils. He mentions that the palæontologist can often trace such a "unit character" in any particular group of fossil organisms through successive periods of time, and as such he finds it of great value in working out evolutionary series. "The peculiarities of the unit characters are: (1) the unit character undergoes serial change, both in development and evolution, (2) serial change in development is parallel to that in evolution, (3) the time of onset of a character and of its successive phases of change varies in different individuals and changes progressively in successive communities, (4) the rate of change in expression of a character varies in different individuals, but becomes progressively more rapid in successively later communities, (5) unit characters behave independently of one another."

The Feeding Mechanism of Branchiopoda.

PROF. H. G. CANNON in an interesting paper (*Phil. Trans.*, **B. 222,** 1933) describes the feeding mechanism in the four orders—Anostraca, Lipostraca, Cladocera, Conchostraca and Notostraca of the sub-class Branchiopoda. The order Lipostraca is particularly interesting since it is only represented by a fossil form Lepidocaris. According to Prof. Cannon, from a structure like the gnathobase of Lepidocaris, the gnathobases of all the orders enumerated above except Notostraca, could be derived. In describing the possible line of evolution of the filtering trunk limbs in the five orders, he points out how in the original Branchiopod the anteriorly directed food stream developed secondarily and therefore it is not an effective mechanism. Consequent on the increase in the size of particles and decrease in the effect of suctions, the basal endites become modified along two lines, into structures of greater efficiency. On the one hand the Notostracan apparatus with endites projecting forwards and with no food grooves was evolved, while on the other, an apparatus with endites projecting backwards was formed in Anostraca, Cladocera, Conchostraca and Lipostraca. In these latter groups, filter setæ were developed and therefore the endites functioned both as food procuring and filtering agents. These are called siniognathobases. Further Prof. Cannon points out that the proper functioning of the Branchiopod phyllopodium (or the ultimate filtering limb) depends on the backwardly projecting exites, endopodites and endites from the thickened corm. He suggests that together with the body wall at the base, the shape of the limb is that of the bath and therefore the word 'droitopod' may be substituted.

The Study of Golgi Elements.

LAURA J. NAHM (*Journal of Morphology*, **54**, 2, 259, 1933) arrives at some very interesting conclusions believed to be of value in at least a partial clarification of the confusion which exists among modern investigators concerning the morphology, chemical composition and the functional significance of golgi elements and her results are not in accord with the existing theories of morphology and functional significance of the golgi apparatus. The golgi elements of fixed cells and the neutral red vacuoles of vitally stained cells are not constant morphological cell constituents but are the visible products of chemical reactions that occur in the cell. Neutral red reactions in the gland cells of a number of vertebrates show that the neutral red is not a specific stain and the capacity to stain with this vital stain depends on the kind and physiological state of the cell and the presence of acidic substances. The capacity to reduce osmic acid is not a specific property of any morphological element of the cell. The impregnation of salts is conditioned

by the chemical constituents of the protoplasm and vary with the quality of initial fixation and temperature of incubation. The materials that give rise to the so-called golgi are probably unsaturated fatty acids which may be present in cells at the time of fixation or may be formed during the process of impregnation from materials which were present in the living cells.

Basophil (Mast) Cells in the Alimentary Canal of Salmonoid Fishes.

LLOYD L. BOLTON (*Journal of Morphology*, **54**, 3, 549, 1933) has described basophil (mast) granule cells in the connective tissue throughout all the regions of the alimentary canal of Salmonoid fishes. Various theories and problems arising from the consideration of these cells have been briefly reviewed. The granule-bearing cells are mostly basophilic. Since their origin is traced to a more or less mesenchymal type of cell, it is contended that they are to be interpreted as connective tissue mast cells. The author finds no support to the suggestion that these cells are of the nature of secretory leucocytes and their presence in the tissue of the alimentary tract is without reference to the functional activity of the digestive canal. Further the mast cells do not show any obvious morphological change to be synchronised with the variations in the functional conditions of the tract. Their enormous number and the remarkable uniformity of appearance under varying conditions suggest that they may be degenerative cells with a probable function related to food storage. The mast cells exhibit amœboid movements and are found commonly between the crypts of the glands of the stomach and come into close relationship with the gland cells. The spherical granules contained are not lipoid in nature as they are not preserved by osmic acid and a protein composition is suggested as they are readily preserved by mercuric chloride. In living cells the granules are probably fluid and are interpreted as histogeneous mast cells.

Dahlia Diseases.

AMONG the valuable contributions of the Boyce Thompson Institute (**5**, No. 2), Philip Brierley's comprehensive study of Dahlia Diseases will greatly interest those interested in virus diseases of plants. Dahlia mosaic is suspected to be widely distributed and all the members of the genus *Dahlia* tested have proved susceptible but no suspects have been found outside this genus.

The symptoms of the mosaic are chlorotic bands following the veins, leaf distortion, shortening of internodes and flower stems and vein necrosis. Great variation appears in the reactions of different varieties, the more tolerant varieties showing only chlorotic symptoms. The disease is not known to disseminate through seeds, nor has the virus been transmitted by mechanical methods. Grafting, however, is a successful means of disease transmission and the diverse symptoms exhibited by tolerant and intolerant varieties are merely varietal reactions to one mosaic.

Myzus persicæ has been shown to be a vector of dahlia mosaic; other insects, experimented with, have so far not been able to transmit the virus.

The interval between infection and manifestation of symptoms is usually four to six weeks, but in some cases much longer. Late season infections in particular tend to show symptoms after a long interval, often not until the following season. The expression of symptoms in mosaic plants is often delayed in early season growth. The chlorotic symptoms of mosaic are frequently masked during the growing season. It is suggested that masking is determined by growth relations rather than by any single environmental factor.

Dahlia is not a preferred food plant of *Myzus persicæ* in early summer. Limited evidence suggests that some infections take place in July, and that more occur in September and October.

The rate of spread of mosaic in the field has been found to be of the order of 10 to 25 per cent. per year at Yonkers and New York.

Control of mosaic by selection and isolation of disease-free plants, supplemented by control of aphids during the period of greenhouse propagation and roguing, is recommended. Tolerant varieties affected with mosaic should be segregated from the healthy stocks, if grown at all.

Dahlia ring-spot is generally distributed in Connecticut, New Jersey, and southern New York, but has been found in high percentages in a few localities only. This disease has been transferred by grafting but

not by mechanical methods. The relation of ring-spot to mosaic is discussed.

Yellow ring-spot, seen only in dahlias received from Utah, has been transmitted by grafting but not by mechanical methods.

Oakleaf is tentatively described as a fourth virus disease of dahlia solely on the basis of symptoms expressed. None of the four virus diseases of dahlia, described in the paper, has been connected with other known virus diseases.

A New Blood Fluke from an Indian Tortoise, *Trionyx gangeticus*.

IN the *Journal of Helminthology* (Vol. XI, pp. 163–68) Dr. G. S. Thapar describes a new genus of blood flukes from an Indian tortoise from Lucknow. The genus is named *Tremarhynchus* and belongs to the sub-family *Hapalotreminæ* Stunkard, 1921. Several forms have already been described from the tortoises in the West under two genera *Hapalotrema* and *Hapalorhynchus*, but this is the first record of the occurrence of the hermaphroditic blood flukes from India belonging to this sub-family. The author describes its anatomy in detail and concludes with a discussion on the systematic position of the new genus. The genus is interesting in several ways, particularly so because it shows its affinities with both of the known genera of the sub-family *Hapalotreminæ* and thus serves as a sort of connecting link between them.

Spermatogenesis of *Gecko japonicus*.

SU-HSUEN WU (*Journal of Morphology*, **54**, 3, 593, 1933) in his study of the Spermatogenesis of the *Gecko japonicus* offers evidence in favour of telosynapsis and the duality of the chromosomes from synizesis to diplotene is the result of a longitudinal split in the chromosomes joined end to end. There are twenty tetrads in diakinesis and the chromosomes assume a rod-shape at metaphase. The movements of the chromosomes in the first division which is the reducing division are not synchronous. There is no interphase between the first and second divisions and the movements of the chromosomes in the latter division are synchronous. An unequal pair of chromosomes (heterochromosomes) is found in early metaphase and generally lags behind the others forming the equatorial plate. The haploid number is 20.

Science News.

The celebration of the Centenary of the Entomological Society of London on the 3rd, 4th and 5th May was marked by the announcement that His Majesty has been graciously pleased to grant the Society the privilege of being henceforth known as the Royal Entomological Society of London.

The Entomological Society was founded on May 3, 1833, when a few British naturalists met in J. G. Children's rooms in the British Museum, Bloomsbury.

The Centenary celebration included a first class display of modern entomological exhibits together with interesting volumes of the Society's library which included hand-painted figures of insects and the Society's obligation book containing the signatures of such distinguished fellows as Kirby, Darwin, Wallace and Bateson. Numerous charts, photographs, models and drawings gave one a magnificent idea of the different aspects of entomology. Both the academic and economic aspects of the subject were well represented. The exhibition indicated the lines of the rapid advancement of this important branch of science to which the Society that organized it contributed not a little.

* * *

H. E. Sir Fredrick Sykes, the Governor of Bombay, opened on the 7th July, the University Conference at Poona, which was presided over by Dewan Bahadur S. T. Kambli, Minister for Education. In the course of his remarks, His Excellency said that it was time that the Bombay University should be relieved of some of its numbers which were growing almost to unmanageable size and showed no signs of diminishing in the near future. There can be two types for new Universities; one is the regional and the other, residential. The difficulty lay in preventing these Universities from becoming centres of disruptive forces engendering a narrow, commercial outlook full of racial and linguistic prejudices. Whatever be the type of University that may be created the initiative must come from the people. The Government with its difficult financial position, can offer but very little help. Its immediate duty was to restore the grants in full for secondary education.

We believe that there is a great future for Maharashtra University which aims to express Maharashtra Culture. In such a case, Poona would be eminently suited for its centre and the existing Women's University would then be absorbed in the new one. While finance is the greatest obstacle to any immediate realization of this aim, it should, however, be emphasized that if the new University becomes a copy of the existing types turning out innumerable graduates every year whose future is a problem both to them and to the country, it had better

be not even attempted. If it can adjust itself to the new conditions of the country and aim at producing citizens who will be useful to themselves and others, it would be a great step in the educational progress of greater India. We earnestly hope that the founders of any new University in the country will have this ideal as their objective in their labours.

* * *

The inauguration of a Chemical Technology course in the Indian Institute of Science from the July of this year marks a distinct step in the progress of technical education in India. The course which will cover two years, is intended to train a few graduates of different universities to fit themselves for the factory. The need for such trained men in the country is great and no doubt will be greater in the future when the development of Indian industry will become part of the task of national reconstruction. We hope that the results of this experiment will encourage the authorities to widen its scope to accommodate more students and give them a broader training in methods of chemical technology.

* * *

The Andhra University Commission that was constituted with Sir S. Radhakrishnan as Chairman has issued its report. The report contains details of the itenerary in the Andhra districts and the procedure of inspection generally followed by the Commission.

The principles of management of the several colleges, the tone of internal discipline and administration, staff, finances, buildings and hostels of each institution are separately dealt with and a number of useful suggestions are made for their improvement. The Commission is of the opinion that organized steps must be taken to make physical education more widely compulsory and efficient. We note that the libraries of almost all the institutions have come in for a good deal of criticism and library work in general has been ill organized. The Commission makes some very valuable suggestions to remove this defect. The Commission finds that tutorial work is not generally very conscientiously carried out and that there is much spoon-feeding with regard to the teaching of English.

The Commission recommend that the association of practical work in mathematics with theoretical work, which has fallen into disuse or neglect, should be revived and all colleges teaching the subject should be provided with the necessary apparatus which are generally inexpensive. The need for employing people with research qualifications in the teaching of physics and chemistry is strongly emphasized as also the necessity for these teachers to be up-to-date in their knowledge. The Commission recommend the opening of more classes in Biology and also the establishment of a marine biological station at Vizagapatam with a museum and an aquarium attached to it. The importance of magic lanterns in every college and their frequent use are pointed out. The teaching of History seems to be sorely neglected and the reasons are probably overlecturing, failure of the proper use of the library and tutorial work and a lack of genuine interest on the part of teachers. The improvement of the library and the encouragement of reading or publishing original papers are advised. It is also recommended that future teachers of the vernacular languages, Telugu and Sanskrit, must be those who have a good foundation of English. At present it is difficult to get teachers possessing these qualifications and it is hoped that the new courses instituted by the University will supply the need.

A complete survey of the colleges of Andhra area has been undertaken by the Commission and their recommendations, even if a little sketchy, are of great interest as points to be borne in mind when establishing new colleges by any University or Government. It would have been more helpful and illuminating if the report had been written taking into consideration the interests of future universities and colleges so that it could have served as a useful guide to educational authorities.

* * *

In *Current Science* (June 1933) the views of Mr. P. C. Biswas with regard to Mr. Sarkar's article on the 'Mâlers and Malpaharias' (*Current Science,* April 1933) were published. From a letter of Mr. Sarkar to us we learn that his article is a short summary of the result of five years' field work among these tribes. His views are in accordance with those of Dalton, Buchanan, Risley and Roy, and Mr. Biswas has not produced good evidence for the theory of the dual origin of the Mâlers and the Malpaharias.

While Mr. Biswas says that he was not able "to discover a single case of intermarriage" of the Mâlers with the Malpaharias Mr. Sarkar has found more than one such instance and in fact produces a photograph of the Mâler wife of a Malpaharia male.

He adds, "It must be noted that the distinction between the two tribes is not always marked. On the border country, *e.g.*, Bungalows Litipara and Kunjbona in Pakur, there are people who call themselves Malpaharias but speak Malto and *intermarry with Saurias.*"

Before one can accept Mr. Biswas' statement that there are thirteen classes among them instead of eleven as stated by Sarkar, it should be thoroughly ascertained that they are not local variations due to difference in pronunciations, and also genealogies showing these names have to be produced as evidences.

* * *

Ants carrying Aphids during their Nuptial Flight. S. Jones, Esq., Department of Zoology. College of Science, Trivandrum, writes :—

"It is a well-known fact that certain species of ants keep and rear aphids in their nests and live in close association with them.

At about five in the morning on November 2nd, 1932, my lamp was surrounded by a large number of winged male and female ants. The ants were small and honey-coloured, and generally resembled the genus Solenopsis. (The workers belonging to this species have a peculiar habit of erecting their abdomens perpendicularly when irritated.)

Evidently those that came to my table were on their bridal flight, and were attracted by the light. The females were markedly larger and hardier than the males, and they were noticed to carry something white in their mouths which was later found to be a species of Aphids. It was interesting to note, that the females alone carried the creatures and the males did not. They would occasionally deposit their load on the table and pick it up again. The female ants migrating to establish new colonies were evidently carrying

the aphids with them so that they could be reared in their nests.

A few weeks later, I found a nest of the same species of ants with the same species of aphids they were rearing. The aphids were feeding on the small rootlets of a jack tree.

The antennæ of this bizarre-looking aphids were markedly large, and the legs so small in comparison to the size of the body that it could walk but clumsily. No trace of the eyes could be seen, and it appeared to be completely blind. They were wingless and the whole body was covered with hairs, of which those at the posterior end were very long. Each aphid had two or three eggs in its body.

Would any readers of *Current Science* kindly inform me, if during the nuptial flights of these ants, the females alone carry the aphids?

* * *

In the course of a communication on the *Egg-laying Habit of the Marine Bug, Halobates*, Mr. Jones says, " In the *Cambridge Natural History*, Vol. VI, Part II, page 552, Sharp, in his description of Halobates, says, 'The young are frequently met with but there is no doubt that the whole life-cycle may be passed through by the insect far away from land. The Italian ship *Vettor Pisani* met with a bird's feather floating on the Ocean of the Galapagos Island with eggs which proved to be those of Halobates in an advanced state of development.'

Our College Museum possesses a cuttlebone covered with the eggs of Halobates picked up from Kovalam Coast, a few miles away from Trivandrum. During February 1932 I found that many of the cuttlebones washed ashore had the eggs of Halobates laid on them.

The eggs are laid in large numbers and very close together on the convex surface of the shell. The eggs are also laid on the concave surface but never in such large numbers as on the convex side.

The eggs are orange-yellow in colour, long and almost uniformly broad with both ends rounded. The greatest length is 0.90 mm. and the greatest breadth is 0.42 mm.

A piece of cuttlebone with eggs on it was kept in the laboratory for a few days and some of the eggs hatched out as tiny nymphs."

* * *

Stoppage of Research Ruined Chocolate Industry in Ecuador.—A clean cut example of the short-sightedness of "economy" that results in the stopping of scientific research is offered by the South American Republic of Ecuador. The depression hit there earlier than it did in the United States, an economy programme stopped research, and the evil harvest thereof is being reaped.

Fifteen years ago, Ecuador, then one of the principal exporters of cacao, was disturbed by a disease attacking the pods from which the chocolate is manufactured. Although the value of the cacao exceeded that of all the rest of the country's exports combined, there had been no serious attempts to protect it against pests. Studies of this disease were begun, but with the depression of 1921 most of the research work was discontinued; in a few years the uncontrolled spread of the disease forced the abandonment of one of the best of the cacao varieties.

The lapse in the cacao research work proved doubly inopportune. Just at this time a witches-broom disease became conspicuous in one of the important cacao districts. In four years the yield in this district declined to less than one-fortieth of its original volume, and the jungle has taken many of the plantations. The disease spread to other parts of the country and the cacao exports of Ecuador during a period of increasing world consumption dropped by 1930 to less than half their former volume. Resumption of investigative effort has shown that resistant varieties can be produced and the industry may be re-established but too late to save the existing plantations in the regions most affected by the disease.—*Science Service.*

* * *

Mosquito and Charophyta.—Mr. S. C. Dixit, Wilson College, Bombay, writes: " The following list of species of Charophyta having no larvicidal properties and found at Santa Cruz is given at the invitation of Dr. Gosh in his reply (*Cur. Sc.*, April, 1933) to my note on the subject.

1. *Nitella hyalina* Agardh. 2. *Chara succincta.* 3. *C. flaccida* A. Br. 4. *C. zeylanica* Willd.

One is at a loss to find how opinions freely expressed in journals on matters scientific could kill further research on the subject."

* * *

" The Chromosome number of *Crotalaria juncea* Linn."—Mr. R. M. Datta, Department of Botany, Presidency College, Calcutta, writes:—" The plant is a 'rigid shrub cultivated generally and sometimes spontaneous'. (Prain 1903.) The small flower buds were collected from plants on bright sunny days and with a view to counting the chromosome number of this crop plant the anthers were taken out from the small flower buds and teased in a drop of aceto-carmine solution as described by Belling (1926). The metaphase plate in the pollen mother cells showed the haploid number to be 10. Chromosomes are small and rounded but the present writer is not definite about the shape and size of each bivalent."

* * *

In delivering the inaugural address before the Geological Society, Central College, on Thursday, 10th August, Professor L. Rama Rao dealt with the recent advances in our knowledge of the origin of Angiosperms. After giving a critical review of the earlier ideas held regarding this problem, the speaker discussed at some length the hypothesis of the origin of Angiosperms from the Bennettiteans and pointed out how recent studies have shown the impossibility of 'deriving' the Angiosperms from these mesozoic Cycadeoids. He next referred to the interesting group of Jurassic Angiosperms—the Caytoniales—described by Dr. H. H. Thomas in 1925 and showed how this group was definitely more closely related to the forms from which the modern flowering plants sprang. An intensive study of the Caytoniales led Dr. Thomas to put forward the hypothesis of the origin of Angiosperms from several distinct groups of pteridosperms, an idea which derives some further support from the study of some of the recently discovered pteridospermous plants from the Mesozoic rocks of South Africa.

* * *

We acknowledge with thanks the receipt of the following:—

"Nature," Vol. 131, Nos. 3319 to 3323.

"The Chemical Age," Vol. 28, Nos. 728 to 730; Vol. 29, Nos. 731 and 732.

"Berichte Der Deutschen Chemischen Gessellschaft," 66 Jahrg, Nos. 6 and 7.

"Journal of Agricultural Research," Vol. 46, Nos. 8 to 10.

"Memoirs of the Indian Meteorological Department," Vol. 25, Pt. 10.

"Le Cycle Conidien," Vol. 41, No. 4.

"International Geological Congress Pamphlets," 4th Circular and Supplement.

"The Origin of Crochet & Anastomose, Mycological Society of France," Vol. 48.

"Journal of Chemical Physics," Vol. 1, No. 6.

"The Indian Forester," Vol. 59, No. 7.

"Scientific Indian," Vol. 9, No. 54.

"The Mathematics Student," Vol. 1, No. 1.

"Canadian Journal of Research," Vol. 8, No. 5.

"Analytical Methods for the determination of Levulose in Crude Products, U. S. Dept. of Commerce," Research Paper No. 495.

"An Analysis of Lanthanum Spectra (La I, La II, La III) U. S. Dept. of Commerce," Research Paper, No. 497.

"The Review of Scientific Instruments," Vol. 4, No. 6.

"Bulletin of Applied Botany, of Genetics and Plant-Breeding," III Series, No. 2.

"Problem of Alkaloides Lupin."

"University of Cambridge School of Agriculture Memoirs," No. 4.

Boyce Thompson Institute for Plant Research, —*Professional Paper*, Vol. 1, No. 23, "The Injurious Effect of Mercury Vapour from Bichloride of Mercury in Soil of Rose Houses," by P. W. Zimmerman and William Crocker.

Professional Paper, Vol. 1, No. 24. "Properties and Uses of Calcium Cyanamide," by M. M. McCool.

"Contributions from Boyce Thompson Institute," Vol. 5, Nos. 1 and 2.

"American Journal of Botany," Vol. 20, No. 6.

"Journal de Chimie Physique," Tome. 30, No. 5.

"Science Progress," Vol. 28, No. 109.

"Natural History," Vol. 33, No. 4.

"Experiment Station Record," Vol. 68, No. 6.

Reviews.

MODERN THEORIES OF DEVELOPMENT: *An Introduction to Theoretical Biology*. By Ludwig von Bertalanffy, translated and adapted by J. H. Woodger, 1933. (Oxford University Press, London; Humphrey Milford, pp. x+204. Price 8*s*. 6*d*. net.)

This little book is an excellent contribution to the philosophy of Zoology and although named an Introduction, it is fit to be in the hands of advanced students of natural science. The first part of the book is devoted to a critical examination and an evaluation of the leading current theories of the phenomena of life processes. Theoretical biology properly deals with the logic and methodology (including the descriptive and experimental branches) of the vital phenomena of metabolism, development, behaviour, nutrition, reproduction, inheritance and so forth, and the investigations into these topics sometimes touch upon philosophical and cosmological problems also. All these processes are so organized that their main purpose is the maintenance of the wholeness of the organism. The deducing of general rules from the consideration of these vital phenomena is the chief function of general biology.

After analysing the mechanistic conception of the biological events, the author comes to the conclusion that the physicochemical explanation of the physiological processes does not comprehend the whole problem. Mechanism naturally leaves out of account the fundamental problems such as the specific characteristics of organisms, the organization of vital processes among one another and the historical character of the living organisms and their organic wholeness. The opposite theory of vitalism though it recognizes organic wholeness, refers all the phenomena to a metaphysical or psychical agent and thus precludes the possibility of a scientific explanation. The book sets out to seek a new standpoint which takes account of the organic individuality and wholeness capable of being treated in a manner admitting scientific investigation. This viewpoint is known as *Organismic biology* or the system-theory of the organism. The object of biological investigation is not living substance which has no existence, but living organism. A living organism is conceived as "a system organized in hierarchical order of a great number of different parts in which a great number of processes are so disposed that by means of their mutual relations within wide limits with constant change of the materials and energies constituting the system and also in spite of disturbances conditioned by external influences, the system is generated, or remains in the state characteristic of it or these processes lead to the reproduction of similar systems." It is clear that we can learn nothing of organisms

as such by studying their parts in isolation but in their natural totality they present phenomena which require concepts other than those provided by the mechanistic and vitalistic theories for an adequate scientific explanation.

The second part of the book is devoted to a review of the theories of development advocated by Roux, Weismann, Driesch, Goldschmidt, Köhler and Przibram and Spemann as explanations of vital processes in general. It is concluded that none of these theories,—machine theory, vitalism, mechanism, physiological theory, gestalt theory, crystal theory and organiser theory,—offer a complete and adequate picture of the developmental processes because they attempt to analyse them into particular occurrences proceeding in single parts independently of one another. Therefore none of these views is justified by the facts. The solution is accordingly sought for in the organismic or system-theory of the organisms. It is to be noted that the idea of 'wholeness' forms a factor of most of the theories which are attempted to be replaced. For the explanation of development and life in general, the system-theory comprehends the polyphasic colloidal system of the germ cell, its organization and its faculties collected in geological times, and it is stated that biology must progress in the future towards a complete and satisfactory conception of the biological events of organisms. Two fundamental principles are involved in the system or organismic biology. The first is the law of biological maintenance, which implies that the organic system tends to preserve itself. The second is the principle of hierarchical order which implies that every organism exhibits higher and lower levels of organization both in the static and dynamical sense.

The organismic conception of vital phenomena, no doubt offers new prospects for a more comprehensive view of life and opens out fresh fields in the methods of investigation. The limitation of space imposed by the review forbids a more detailed examination of the theory of entelechy and it seems to us on theoretical grounds that if purposiveness is eliminated from the theory of life, biology reduces itself to a branch of physics and the resources of physical sciences will be found deficient to explain fully the behaviour and evolution of organisms.

In Woodger we have read a remarkable little book which within a short compass offers a brilliant critical analysis of the current biological theories of life processes and after pointing out their inadequacy to give a complete picture, offers a new explanation based on the facts of experimental embryology, which, besides being a satisfactory working hypothesis, possesses a great heuristic value. We have pleasure in offering the book a cordial welcome as an important contribution to scientific literature and in congratulating the author on a clear, precise, and dispassionate presentation of the subject. A full list of literature is provided for the benefit of those who might wish more information than the book offers.

* * *

MODERN BIRTH CONTROL METHODS OR HOW TO AVOID PREGNANCY. By George Ryley Scott with a foreword by Sir W. Arbuthnot Lane. (John Bale & Sons and Danielsson, Ltd., London, 1933. 7/6 net.)

It is doubtful whether the fig leaf or the apple contributed more to human miseries. In fact, neither theologians nor moralists could conclusively establish how the knees sinned more than the face for their shame to be covered. Anything actively and carefully hidden excites unrestrained curiosity and it is true that familiarity breeds indifference. Social progress is measured by the amount of clothing, sophisticated food and sex crimes, besides other standards. Writing in defence of the veil as a biological necessity Sir Mohamed Iqbal points out that woman is a paramount creative element and therefore holy and that in nature the creative forces are hidden. Both these statements are partially true and if nature had really intended that her creative powers should be hidden from gaze, she would have provided her creatures with a natural investment. Among people who wear minimum clothing, the rate of fecundity is very low and the sex attraction is predominant only during the season, while highly seasoned food, heavy clothes and family propinquity favour a high birth rate and medical relief conserves the biologically unfit. According to the doctrines of birth control, the remedy for the rapid multiplication of human population is a widespread practice of contraceptive technique.

It is usually maintained, not by the author of the book under review, that on sociological, economical and eugenical grounds, the knowledge and adoption of

birth control methods are justifiable. We agree that the progress of our civilization should tend towards increasing improvement of the human race, but doubt whether the means suggested will procure the end. If, for instance, the lawyer of Corsica had practised the principles of birth control, the world would not have witnessed the birth and career of Napoleon. This may be said of some of the greatest men and women who have adorned and enriched the age in which they were born. When we talk of the increasing human population we seem to think that the geographical area of the world for colonisation and cultivation is shrinking and that the natural resources to be harnessed for the service of man are nearing exhaustion and that Chemistry has said the last word in regard to the productivity of the land. We have recently been witnessing enormous quantities of coffee burnt, wheat thrown into the sea, and milk poured into the rivers. Assuming that on sociological and eugenical grounds, the government are convinced that birth control methods are to be legally enforced, though none of the writers advocate it yet, we shall have succeeded in producing a society of moralists, saints, wise men and good men. An immaculate and infallible society such as this in which the children lisp the Ten Commandments and men know nothing but holiness and goodness, it is doubtful if some ingenious members will not have the curiosity to experiment on the opposite qualities. This is precisely what happened in that ideal place which we call Heaven and the attempt to establish a night club among the celestials is the subject-matter of the greatest epic in English literature. Has human society any assurance that in preventing the birth of the socially and eugenically unfit, we do not also prevent the birth of saints, geniuses and philanthropists? Are we sure that in abolishing crimes and lunacy we shall succeed in providing the human society with the means of eternal satisfaction, with the purity of morals and a uniform and high rate of standards of efficiency among its members? We shall have a race of population soon not unlike a vast landscape covered with white snow. We attach a value to whiteness because of the presence of the opposite attribute and if everything is white or uniform the whole conception of ethical values and that of the significance of standards will cease to exist. This very weight of monotony is bound to produce an insatiable appetite for variation. Human society derives its picturesqueness from the innumerable gradations of levels just as a landscape owes its beauty to undulations of ground and differences in the size and colour of plants and trees all blended into a vista of magnificent irregularity. Would any advocate of birth control visit twice a zoo where you have a symmetrically arranged series of small marble ponds, filled with distilled water and peopled by white swans with the same colour on the beaks and feet and with nothing else? What would be the condition of man, if we had only oranges constituting the flora of the world? Frankly we do not know how to use the gifts of nature. We have investigated the medicinal, poisonous and life-sustaining properties of plants and our knowledge, though far from complete, enables us to employ the most dreadful poisons for restorative and curative purposes. If the deadly tobacco can be converted into an object of enjoyment, is there any justification for science to despair of finding uses for defective and dangerous human material in the social organism?

We are not convinced that the sociological, economical and eugenical arguments in favour of birth control are sound, but we entirely agree with Mr. Scott when he says that birth control is a private matter for the individuals concerned and that every married couple have the right to decide whether or not they will practise birth control and that the matter concerns none else. Before, however, the individuals decide upon the course of action, we deem it necessary that they should have a complete knowledge of sex anatomy and physiology, the doctors who advise them must have taken a course in the birth control clinics and all should recognize that the technique is fundamentally opposed to the laws of nature and if possible should have the imagination to visualize the consequences of all such practices on the physical and mental well-being of the future generations of mankind.

The book deals with the subject-matter without passion, prejudice or prudery but with absolute candour, the author sets forth the disadvantages and evils attending the use of the different methods. Perhaps the information regarding the contraceptive methods, when given by books such as the one under review, may be imparted to all

and it may be even necessary to do so lest through ignorance and false shame grievous errors are likely to be committed. When sex education is going to form part of the curriculum of studies in the high school stage, we should have no hesitation in placing a copy of this book in the hands of the young people of both sexes in order that they may have a correct and complete knowledge of the birth control technique also. There are a few statements in the book with which one may not agree. Mr. Scott says that "if truth could be got at, I very much question whether women have ever been as keen on child bearing as they have been given out to be" and then he thinks that they dread the repetition of pains, discomforts and dangers connected with child bearing. We think that Lady Chatterley and Mrs. Bolton in the novel are types and their views on these matters are the unexpressed desires of the generality of womankind.

The usefulness of the book is enhanced by the tables giving indications for the different methods, the clinics and their practice, an account of the societies for the propagation of birth control and a selected bibliography and a useful glossary.

It may be necessary for the nation to be warned about the dangers of over-population but it is imperative that it should be warned also about the consequences which the adoption of the proposed remedy is likely to produce in the social organism by its indiscriminate and ignorant application.

* * *

CONTRIBUTIONS TO THE ICHTHYOLOGY OF SIAM. Siam is a more or less mountainous country that lies between Burma on the west and the French Indo-China on the east. The ichthyology of Burma is fairly well known mainly through the researches of Blyth, Day and Vinciguerra, while the fish-fauna of the French Indo-China has been the subject of investigation by several French ichthyologists of great fame. It has also been known for a considerable time that the fresh waters of both of these countries are inhabited by fishes of remarkable interest to systematists and to students of animal adaptations. As the fauna of Siam has received very little attention, the geographical distribution of these remarkable fishes could not be elucidated properly. So far as the study of ichthyology is concerned, Siam could almost be described as a *terra incognita*. The students of Oriental fishes will, therefore, learn with great satisfaction that Dr. Hugh M. Smith has started to publish in a series of articles his notes on the fish-fauna of Siam. These valuable notes are published as "Contributions to the Ichthyology of Siam" in the Natural History Supplement of the *Journal of the Siam Society*. As many as six articles have already appeared in the series (**8**, No. 4, 255, 1932; **9**, No. 1, 53, 1933) dealing with (i) Descriptions of a New Genus and Three New Species of Siamese Gobies, (ii) New Species of Loaches of the Genus Nemacheilus, (iii) A New Goby of the Genus Vaimosa, (iv) A New Genus and New Species of Glyptosternoid Catfishes, and (v) Fishes Not Previously Recorded from Siam. Dr. Smith's researches have not only brought to light several peculiar and highly interesting endemic species, but they have contributed greatly towards the knowledge of distribution of species found in the adjoining regions. The geographical range of several of the Indian species has been extended and the close similarity between the fish-fauna of Burma, Indo-Australian Archipelago and Siam is indicated.

The new species are fully described, their relationships are discussed and they are illustrated with beautiful delineations.

S. L. H.

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THE MODE OF ACTION OF DRUGS ON CELLS. By A. J. Clark, B.A., M.D., F.R.C.P., F.R.S., (Edward Arnold & Co., London. 1933. Pp. 297. Price 18*s*.)

The book under review is entirely novel in its style, inasmuch as it has completely shown the fact, perhaps now-a-days realized by many of the progressive medical men, that without physical chemistry, there can be no further real advances in the knowledge of at least this branch of pharmacology. To probe into the action of drugs on cells, *i.e.*, to place pharmacology on a rational scientific basis in one of its main aspects, by the application of the laws of physical chemistry, is really a task which can only be undertaken by men like Professor Clark. After going through the book, we have no doubt left that he has shown most ably and very beautifully both the usefulness and limitations of these methods in the elucidation of these immensely complicated systems, where the number of variables are many and the precise scientific methods of attack are few. The book will, of course,

be very useful to pharmacologists and physical chemists alike.

R. N. C.

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Influence of Manures on the Wilt Disease of *Cajanus indicus* Spreng, and the Isolation of types resistant to the Disease. By W. McRae, M.A., D.Sc. (Edin.), F.L.S. and F. J. F. Shaw, D.Sc. (Lond.), A.R.C.S., F.L.S. (69 pp. + 18 illustrations.)

In the series of *Scientific Monograph of the Imperial Council of Agricultural Research*, the above-mentioned publication, which forms No. 7, deserves mention. The research which forms the subject of this Monograph* originated from observations made in the permanent manurial experiments at Pusa in which a differential death rate in *rahar* (*Cajanus indicus*) due to wilt disease was observed in plots which had different manurial treatments.

Part I deals with the influence of superphosphate, cattle manure and green manure on the incidence of wilt and was carried out by the Mycological Section, Pusa. In the Pusa experiments, sulphate of ammonia and of potash showed no effect, whilst cattle manure and superphosphate increased the wilt and green manure definitely tended to decrease it.

The research described in Part II was undertaken with the object of obtaining a type of *rahar* (*Cajanus indicus*) which would be immune, or strongly resistant, to the wilt disease and of elucidating some of those biological factors in the soil which affect the incidence of the disease. The result of the investigation has been the isolation of a type, type 80 (A2) which possesses a considerable degree of resistance to the wilt disease. The quality of resistance has also been found to be present in isolated types 82, 16, 41, 50 and 51. The resistant quality is not correlated with the morphological characters studied. A point of great interest is the loss in the resistance of a resistant type in a field which has been under *rahar* for several years. This loss in resistance, however, is not transmitted to the next generation, the soil conditions which cause the loss in resistance affect the soma of the plants which are exposed to those conditions but not the germ tissue.

The field tests of wilt resistant types were carried out on the Farm and in the Botanical Section by both the Mycological and Botanical Sections.

*The Monograph is *in the Press* and will be issued shortly. Copies of the Monograph, as in the case of other Council's publications, can be purchased from the Manager of Publications, Civil Lines, Delhi.

* * *

An Introduction to Tropical Soils. By Dr. Vegeler, translated by Dr. H. Greene. (Pp. viii+240. London: Macmillan & Co. Price 15*s.* net.)

Since the time Liebig first explained the function of nitrogen, phosphorus and potash in plant nutrition, the study of the soil as the source of these elements commenced. At first, the study was purely from a chemical standpoint, but later on it was extended to physical, physico-chemical and bio-chemical aspects. In recent years, the scope of the enquiry has been extended to the genetical side of the problem from the standpoint of the soil as the medium for crop growth as distinct from the purely geological origin. The result is that the scientific study of the soil has gained in importance to such an extent as to merit the distinctive name *pedology*. It must, however, be stated that the accumulation of data and the advances in soil science were, till a few years ago, based chiefly on the study of the soils of the temperate regions and the information that exists about the soils of the tropics is precious little.

Experience has shown that the knowledge gained from a study of the temperate soils is often inapplicable to soils under tropical conditions. The most important factors concerned in the formation of soils are temperature, rainfall and evaporation. These factors are more intense in the tropics than in temperate regions. It is, therefore, obvious that differences in climatic factors bring about difference in the course and intensity of soil forming processes and in the properties of the resulting soil.

The contribution by Dr. Vegeler on tropical soils and its translation by Dr. Greene is a welcome addition to the meagre literature on the subject. The work deals almost entirely with the soils of Egypt, Sudan, certain American States and Dutch East Indies, and there is practically no information on Indian soils. This circumstance does not, however, detract the value of the publication to workers on soils in India. The book is divided into six chapters of which the fourth and fifth are devoted to a discussion of the views of the different workers on soil formation, of the part played by climate, relief and vegetation

in the formation of tropical soils, of 'Rain factor' and of theories on weathering.

Tabulated statements for the examination and identification of minerals are given at the end. The publication will be of considerable use for all those interested in the study of soils.

B. V. N.

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RECENT ADVANCES IN AGRICULTURAL PLANT BREEDING. By H. Hunter and H. M. Leake. (J. & A. Churchill, London. 1933. Price 15*s*.)

This forms a sister volume to two other books by the same publishers, "Recent Advances in Cytology" by Darlington which is a comprehensive treatise on Karyology, the new science of the nucleus, and "Recent Advances in Plant Genetics" by Sansome and Philip which gives a summary of the most recent developments and views on the phenomena of inheritance in the plant kingdom in general. The three books together meet a great felt need of the present-day geneticist and plant breeder. The present book, according to the authors, has for its object "to present a complete record of all recent investigations with Crop plants". Realizing the magnitude of the task attempted by the authors they have to be warmly congratulated on the very successful way in which they have been able to condense all the salient features of such work in a volume of this size. The introduction for the book written by Biffen, who may be styled the father of breeding work with agricultural crop plants, points out clearly the limitations of this work and how it is inter-related to improvement of cultural and soil conditions. Work done in India has already confirmed the experience of the West that improved strains of crops give a greater response to improved cultural and manurial practices than unselected low-yielding types.

The book reviews practically all the remarkable achievements of breeders of economic crop plants. This is the first useful English publication of the kind after Fruwirth's manual in German published years ago and should make an excellent reference book for all crop breeders giving them an idea of the advances that have been made in recent years in crops other than those they are concerned with. The book is divided into two parts, the first one dealing with crops of the temperate regions and the second with crops of the tropical and sub-tropical regions. There is a chapter devoted to each of the crops arranged more or less in the order of their importance and the volume of work done on each of them. For some of the crops where the work has not much advanced, such information as classification, floral morphology, etc., are included in the chapter. Under each crop, the subject is treated from a historical point of view describing the economic conditions which faced the early plant-breeders and giving the origin and pedigree of the most important varieties and strains of crops that have played an important part in the improvement of crops of particular countries. In certain of the chapters are included valuable indications of breeding procedure. The great value of the book can be realized from the fact that it reviews work done in practically every part of the world including Russia which probably stands foremost at present with regard to crop improvement work and which is not sufficiently known outside.

Breeders in the tropics will probably realize the difference in the stage of breeding work that exists between them and those of temperate regions and the headway they have to make to reach up the level of work done in crops like wheat, oats, etc. The book should surely give them valuable guidance for attacking their problems from the solution of similar problems tackled in the temperate regions.

So far as India is concerned we see practically every important work done in recent years in crops (upto 1931) included. There is, however, one significant omission in that there is no reference to Howard's work on wheat in the chapter dealing with this crop.

From the intensive nature of work that is being carried on recently in countries like India, the book, particularly portions of it dealing with the tropical cereals, may require revision at an early date.

K. R.

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LUBRICATING AND ALLIED OILS. By E. A. Evans. (London: Chapman & Hall, Ltd. Pp. 170. Price 9*s*. 6*d*.)

After an interesting but rapid sketch of the history of petroleum and its refining and after reviewing also the sources of occurrence of various fixed or fatty oils, the author enters at length into the discussion of the different modes of physical and chemical tests of the lubricating oils for which a good portion of the book is devoted. The

treatment besides being lucid is intensely practical. In the chapter on the decomposition of petroleum the subject of carbon deposit, on the under side of piston and on the piston head and also in the combustion space, is very ably discussed and the author establishes the fact that the deposit is the result of oxidation. It is not coke or residue left over from the oil.

Without a sufficient working knowledge of the lubricants, it is exceedingly difficult for the chemist to prepare specifications for lubricating oils. The author has placed his special knowledge and experience at the disposal of the chemist and also the engineer and gives very valuable hints to them on the selection of the lubricants, dwelling particularly on specific gravity, viscosity, flash point, loss on evaporation, cold test demulsification value, acidity and liability to carbonise.

The concluding chapter deals with oils suitable for different kinds of machinery and the suggestions given therein appear to be eminently opportune. Most of the types of machinery employed in every day use are dealt with and a suitable lubricant is indicated. We have no hesitation in recommending the book both to the chemist who has to deal with analysis and has to draw up specifications for lubricants but also to the engineer who has to choose and use them. V. G.

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"ERGEBNISSE DER ANGEWANDTEN PHYSIKALISCHEN CHEMIE" Band I, edited by Max Le Blanc, Leipzig, with collaboration from Bergius, Bischof, Heinze, Kroger, Maurer, Valentiner. Pp.xi+417.(Leipzig: Akademische Verlagsgesellschaft m.b.H. Price RM 28·50.)

The book embodies the most recent advances in five distinct subjects without omitting the more important work of fundamental nature of the past upon which such progress has been built. These subjects are: (I) Methods for improving fuel materials, (II) physical chemistry of manganese reaction in the manufacture of steel, (III) manufacture of sugar from wood and similar products, (IV) fundamentals and limits of the elastic properties of caoutchouc and similar substances, (V) modern problems in the preparation of ores and coals, each one of which has been dealt with by competent authorities. The scope of these subjects, without being diffused, has been so judiciously chosen that the reader has a real pleasure in finding all that he seeks to ascertain the general trend of the development in these lines. For the student, specially, this volume is extremely useful, as it gives him a clear notion of the latest improvements, and the deficiencies in processes which he can take upon himself as subjects of research. The printing and the illustrations leave nothing to be desired, and the editor, authors, and the publisher are to be congratulated upon for removing a long-felt want of such a publication in the region of applied physical chemistry.

H. K. S.

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ARMCHAIR SCIENCE: '*The Mechanism of Nature.*' By Prof. E. N. DaCosta Andrade. '*At Home among the Atoms.*' By Prof. James Kendall. (Bell's Popular Science Series, London: George Bell & Sons, 1932. Price, 4*s.* 6*d.* each.)

In 1661, Robert Boyle wrote, "A person anything versed in the writings of chymists cannot but discern by their obscure, ambiguous, and almost ænigmatical way of expressing what they pretend to teach, that they have no mind to be understood at all, but by the *Sons of Art* (as they called them), nor to be understood even by those without difficulty and hazardous trials." This complaint is only too frequently justified. The average book on chemistry, with a few exceptions, is dull and dry, full of experimental details which the lay-reader has no chance of performing or see performed and equations and formulæ that puzzle him sorely. The press is full of popular articles on protons, electrons, photons and now is added to these, the positron. These articles generally leave the reader either muddled or misunderstood. Many of the recent developments in atomic structure are uncertain and even experts differ in their opinion; one needs, therefore, a good background of the previous knowledge of the subject to understand or appreciate the latest addition.

The average man with a good education has little time or patience to get this foundation. But he is eager, especially whetted by the lay-press, to know more about the structure and workings of Nature of which he has but faint perceptions based on elementary lessons of the school-room and probably fainter memories of a few lecture demonstrations in chemistry and physics. And later in life he feels he ought to know more. To such people the two books under review are excellently planned.

Prof. Andrade has attempted to convey to the reader the basic principles of heat, energy, sound and vibrations, light and radiation, electricity and magnetism, the quantum theory and atomic structure including wave mechanics without introducing any technical jargon that confounds with its profundity or mathematics that terrifies with its mystery and in this attempt he has succeeded brilliantly. The present edition of the book is an improvement on the first in that, besides eight plates which add interest to the volume, it includes the latest discoveries in the field of atomic physics, namely, recent work on cosmic rays and the disintegration of elements.

Prof. Kendall has rendered his task equally well. Chemistry has been made a story, almost like Cinderella's adventures (the professor quotes her often). Valency, the Periodic Table, Isotopes, Transmutation of elements, the Bohr atom—have all been presented and explained in a language very reminiscent of the fire-side story and few will deny the need for such a book.

We trust that these two volumes will find a prominent place in every public and college library.

K. S. V.

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ELEMENTS OF CO-ORDINATE GEOMETRY. By J. M. Child, B.A., B.SC. (Macmillan & Co. Pp. 468. Price 12*s*. 6*d*.)

Broadly speaking, we can distinguish in any living subject of knowledge, three fronts corresponding respectively to the current contributions to the journals, which exhibit knowledge in the making, the standard treatises in the subject, which expose completed and perfected theories, and the text-books for use in colleges which indicate the level of teachers and of general education, and shew in what measure the gains of knowledge have come down from the specialist and the discoverer, into general currency. In a rapidly advancing experimental subject like Physics the distances between the different fronts may be considerable. It is otherwise with a subject like Geometry—meaning the geometry of the linear group and its sub-groups. The general ideas of this subject were more or less completely thrashed out during the last century, and the subject has settled down into coherence of shape and definiteness of scope; it is this logical perfection and roundedness of form which give to Geometry its high educational value, and its cultural and æsthetic supremacy among intellectual disciplines. We accordingly do not find here any very considerable difference between the first two fronts; but the text-books still lag very much behind. They have not yet assimilated the subject, and are not oriented towards its major ideas. To bridge this gap is the problem before the teacher and the text-book writer.

The general defect in all college books on co-ordinate geometry is that they do not pay sufficient attention to the ideas, but present the subject more as a collection of rules; their stress is, in short, on the doing rather than the knowing. In the ideal text-book the conceptual and disciplinary aspects should be found blended together, by the cunning of the teacher's art, into one single process. The conceptual orientation, that is to say, the choice of the ideas to be introduced and stressed upon, should naturally be determined with reference to the major ideas, both general and specific, which have been evolved in the history of Geometry. For example, Klein's great generalization by which any geometry can be regarded as the invariant-theory of a group of transformations would be imaged in an elementary text-book by the attention paid to the formula of transformation of axes, and by stress on the invariance of the metrical relations (distance, angle, etc.) for such transformations. The notion of correspondence, whether between numbers and figures, or between the elements of two figures, is a fundamental and recurring conception in Geometry, and has to be stressed in all its forms and at every stage. Again, while the pole and polar idea is the distinctive feature of the geometry of the conic section, one never finds it treated properly in the text-books, and a similar remark would apply to several other specific ideas of the subject. It is of course inevitable that in course of time, text-books will tend to approach this ideal more and more. In the meanwhile we have to welcome all enterprising attempts of teachers and text-book writers in the reform of Geometry teaching.

The book under review has the excellent get-up which one has learnt to expect, from Messrs. Macmillan & Co. The talented author Mr. Child informs us that the work is the result of an attempt to write a book on Co-ordinate Geometry, which would not be simply a book on Conic Sections. There is no doubt that Mr. Child has succeeded

admirably in his purpose, even though the book is not a very striking achievement from the view-point of the ideal I have explained. Starting with a chapter on Number and Limits, he has explained and exemplified more fully and systematically than any other writer the notions of correspondence which underlie Co-ordinate Geometry. The denial of a separate chapter to the Circle falls into line with this outlook, and is certainly an improvement and a simplification. It is in accordance with the same outlook to treat the normal forms of the parabola, ellipse and hyperbola after the general equation of the 2nd degree. The first half of the book covers the elementary portion; the latter half deals with the advanced portion and includes Harmonic ranges and pencils, poles and polars, points and lines at infinity, Confocal Conics, Systems of Conics, General Homogeneous co-ordinates and miscellaneous methods. The treatment in the later chapters follows Salmon, and has the merit of brevity and clarity.

The author in the introduction claims merit for his novel treatment of the following topics :—

(1) The sign of a line.

(2) The sign of the perpendicular from a point on a line.

(3) The explanation of the line at infinity.

The question of the best way of introducing the line at infinity cannot be discussed in detail here. I shall content myself with remarking, that while everybody will agree that the equation, constant$=0$, for the line at infinity is unintelligible, and that the alternative form, unit of measurement$=0$, may perhaps sound like an improvement, nobody will consider the latter equation to be an 'intelligible' one, as the author appears to do.

As regards the sign of a line and the sign of the perpendicular, let me first remark that they are inter-related concepts. For, by the choice of the positive directions of the x- and y-axes we can fix a positive direction of rotation in the plane. Hence if we require that a line should have a positive moment about the origin, any convention about *either* the sign of the line, *or* about the sign of the perpendicular from a point on it, will determine also the other.

My own opinion is that these two concepts are objectionable ones and should not find a place in a good text-book on Cartesian Geometry. As this is a point on which I seem to differ from all text-book writers, it will be worth while to give my reasons. The angle in Cartesian Geometry always occurs through its tangent, which means that the spirit of Cartesian Geometry does not favour the concept of sign of a line. My criticism against these two concepts is firstly, that they are entirely superfluous (as I demonstrate presently), and secondly, that they are conventional and artificial, and that the precise limits of the convention would not be appreciated by the pupil. If, for example, we agree with the author that the 'positive sign' of a line is that in which the abscissa increases, how are we to convince the pupil that it is natural and proper for the sign to get suddenly reversed, as the line passes the position in which it is parallel to the y-axis? The effect of including such arbitrary hotchpotch conventions in a rational discipline is simply to undermine its efficiency. These two notions are examples of feeble, shadowy imperfect ideas, from which even a rigorous science like mathematics is not entirely free; they should in no case have a place within the well-knit coherence and the clear sunlight of a course in rational Geometry.

The above criticisms derive their strength from the fact that the two notions are entirely unnecessary, that all that matters in elementary Geometry is that the expression $ax+by+c$ takes different signs on different sides of the line $ax+by+c=0$.

To shew this, let me work the following typical problem :—

PROBLEM.—To find whether the origin lies in the acute or obtuse angle between the lines $ax+by+c=0$, $a^1x+b^1y+c^1=0$. The points in one pair of vertically opposite angles give like signs, and in the other pair, unlike signs to the two expressions. The origin gives them the signs of c, c^1. The line

$$(a+\lambda a^1)x+(b+\lambda b^1)y+c+\lambda c^1=0$$

is perpendicular to $ax+by+c=0$, if $\lambda=\frac{-(a^2+b^2)}{aa^1-bb^1}$

The point $\left\{\frac{-(c+\lambda c^1)}{(a+\lambda a^1)}, 0\right\}$ on this line gives the two expressions the signs of $\pm\lambda$, ∓ 1. Hence the origin lies in the acute or obtuse angle between the lines, according as aa^1+bb^1 and cc^1 have different signs, or the same sign.

The author has not only obtained a more complicated result (Art. 46, page 95), but has actually gone out of his way to remark (without demonstration), that the condition

that aa^1+bb^1 be of different sign from cc^1 is sufficient but not necessary for the origin to be in the acute angle!

Salmon himself (whom the author has taken as his model) has mentioned the convention for attaching a sign to the perpendicular from a point to a line, but he does not seem to have taken it seriously, or relied on it as a method. It is a pity that the author has not taken the hint from Salmon's discreetness on this question.

R. VAIDYANATHASWAMY.

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THE CONDUCTIVITY OF SOLUTIONS. By C. W. Davies. Second edition, pp. x+281; 32 Figures. Chapman and Hall, 1933. Price 15*s.*)

The numerous additions to our knowledge of solutions which have taken place since 1929, the date of the first edition of this book, have called for a complete revision of the subject-matter and an increase in its volume. The result is admirable. The author breaks the ground with a brief but sufficient account of the older theories of conduction in solution and, without demolishing them entirely, indicates in what respects they require modification. This is followed by the introduction of the concept of "activity" and a very clear account of the modern theory of inter-ionic attraction. This chapter is one of the best in the book and should be read by all students of physical chemistry even those not specially interested in conductivity.

Experimental methods are next dealt with in detail. The author is conservative in this respect, as judging from manner in which he emphasizes the disadvantages of valve oscillators and similar devices, he evidently prefers a simple coil and telephone detector to any other combination of apparatus. It is true that precision measurements with an alternating current bridge require certain precautions which are not evident until considerable experience in work of this nature has been acquired, but it is difficult to understand why it should be possible to neglect these precautions when an induction coil is used as a source of current. A small omission in this section is the failure to mention the very simple and useful tuning fork controlled "microphone hummer" as a source of current.

Following a valuable chapter on solvent correction, experimental results are dealt with in the light of existing theories, the subject-matter being grouped for convenience under two main headings, very dilute, and more concentrated solutions. Use is made of unpublished data in several cases and solvents other than water are fully discussed. A theoretical section follows dealing with the strength of acids, solvolysis, complex ions, amphoteric electrolytes, the mobility of ions and the degree of dissociation. Finally two entirely new chapters have been added describing the methods used in conductivity titrations and some of the technical applications of conductivity measurements.

When so much is excellent it is difficult to single out any portion for special appreciation or criticism. The main character of the work is its lucidity; a careful balance is maintained between theory and practice, and theoretical explanations are sufficient without being tedious. The printing and diagrams are fully in keeping with the subject matter and play no small part in enhancing the value of the book. The paper is perhaps unnecessarily thick and it is questionable whether a slight loss in attractiveness if thinner material were used would not be more than compensated by the resulting reduction in weight. The book can be recommended with confidence to all who are interested in this fascinating subject.

H. E. WATSON.

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PRINCIPLES OF FRUIT PRESERVATION. By T. N. Morris, M.A. (Chapman & Hall, Ltd., London, 1933. Price 15*s.* net.)

The above publication which is the sixth of the series of Monographs on Applied Chemistry is a welcome contribution. It is an admirable short review of the principles of fruit preservation on scientific lines. There are at present a number of books and pamphlets dealing with the subject but very few of them deal with it from the purely scientific point of view. The book under review, therefore, meets a long-felt want of research workers in the line. Divided into three parts, (*a*) canning, (*b*) jam and jelly making, and (*c*) dehydration respectively, the book deals with the processes involved and just touches on the technical aspects of the subject. Special attention is also drawn to the factors of spoilage and the means of controlling them. The effect of temperature and humidity on fruit-preservation is ably treated and well worth the study of those interested in the subject. Methods of sterilization and the use of antiseptics have been discussed and the limits

of their efficiency indicated. The information provided in this section will prove highly useful in the treatment of a large variety of fruits. The vitamin factor in fruits and its preservation by cold storage has also been discussed by the author. The book is well written and will prove to be of value not only to those who are interested in the subject in a general way but also to those actually engaged on the study of the various technical processes relating to fruit preservation.

B. N. B.

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BIBLIOGRAPHY OF TROPICAL AGRICULTURE, 1931. Published by the International Institute of Agriculture, Rome. (Rome : Trevas, Treccani, Tumminelli, 1932.) (English Edition. Price 10 Liras.)

Until the end of 1930 the International Institute of Agriculture, Rome, used to publish in its 'Monthly Bulletin' of Technical information section of the International Review of Agriculture short bibliographical notes on tropical agriculture, but the subsequent publication of these notes became impossible on account of financial reasons. A strong desire for the revival of these bibliographies was expressed at recent meetings of the Bureau of the Commission for Tropical and Sub-tropical Agriculture of the International Council for Scientific Agriculture and a timely donation by the President of the Institute has now rendered possible the issue of a consolidated bibliography for 1931.

The volume has been compiled by Dr. C. J. J. Van Hall, formerly Director of Agriculture, Surinam, and contains about 450 titles dealing in general with technical publications bearing on tropical crops, papers on economics being noticed only when occurring in publications of a wider scope. Each title is followed by a short summary of the article, and the titles are arranged in 12 principal groups : 'Starch and Sugar Plants', 'Oil-yielding Plants', 'Beverage Plants', 'Industrial Crops', 'Vegetables', 'Fruits', 'Forage Crops', 'Green Manure', 'Cover Crops', 'Species', 'Medicinal Plants', and 'Miscellaneous'. The entries under each crop are arranged in alphabetical order by authors, and an alphabetical author index is provided at the end.

In order to avoid waste of effort, time and money it is essential for every scientist to keep in touch with the work being carried on elsewhere in his particular branch of work but this task is becoming increasingly difficult in these days of extreme specialization. The field of tropical agriculture is so extensive and the literature on it so widely scattered in a number of periodicals issued from different countries and in different languages, that research workers in the tropics find it increasingly difficult to keep abreast of recent developments in their subject.

The provision of annual bibliographies like the present one devoted to this special branch of agriculture, should therefore prove exceedingly valuable to those whose time or facilities for consulting current literature are limited, as by this means they can obtain information on any published literature bearing on the particular lines of the investigation in which they are interested. Though the present bibliography is not as complete as one would have desired, it will be specially valuable as a supplement to the existing abstracting journals and deserves to be brought to the notice of all interested in agriculture in the tropics. At 10 liras the book is not expensive.

It is hoped that the Institute's enterprise in restoring the English edition of this useful publication will be supported by Indian scientists. The official language of the Institute being French, it is only possible in these days of financial stringency to issue English editions of those publications which are in real demand.

1405-33. Printed at The Bangalore Press, Bangalore City, by T. Subramania Aiyar, Superintendent, and Published by K. S. Varadachar, M.A., M.Sc., for the "Current Science" Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore.

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CONTENTS.

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University Reform—II.

WE are indebted to the courtesy of one of our editorial co-operators for a copy of the Report of the Punjab University Enquiry Committee. This document which in several particulars adopts the conclusions of the Sadler Commission Report, provides nevertheless many important and illuminating suggestions of reform. It will be remembered that the Committee was instituted by the Government of the Punjab as a result of the acceptance by the Legislature of a resolution moved in 1931 by Khan Bahadur Mian Ahmed Yar Doultana. In the course of the debate speeches were made urging the appointment of a Committee to investigate the administrative details of the University and to suggest reforms for the better control of affairs. The Committee's terms of reference were restricted to a survey of minor issues such as the composition and powers of the University authorities, the income and expenditure, qualifications demanded from candidates for admission to the University classes and so forth and the more important University problems were left out of the purview of the Committee. Within the limits thus prescribed by the Government, the Report of the Committee, however, contrives to present a body of opinion on current educational problems and suggestions of reform which undoubtedly constitute an important contribution to the already extensive literature.

The University of the Punjab, though it is one of the younger members, has achieved a distinction which reflects great credit on the Province; among its *alumni* are found scientists, administrators, judges and writers whose names are honoured in India and abroad and the output of scientific work from its laboratories has in a great degree promoted the prestige of Indian unofficial research. In the chapter on University Teaching, the Committee make generous references to the important contributions of Professor S. S. Bhatnagar whose work on emulsions and the mechanical condition of coagills and the nature of luminescence and the other chemical implications of the Raman Effect is recognised as a real advance in the knowledge of physical chemistry. Similar references are made to the considerable amount of research work produced in the departments of Rai Bahadur Professor S. R. Kashyap and Dr. G. Mathai and Dr.

Vishwa Nath. Professor Kashyap's ecological studies of the Himalayan and Tibetan flora and his work on liverworts are held in great esteem by the leading botanists and the researches of Dr. Mathai on the marine fauna of Karachi and the cytological studies of Dr. Vishwa Nath have added considerably to the prestige of the University as one of the leading research centres in India. The share of the departments of Mathematics, History and Economics in building up the reputation of the University is not inconsiderable. Among the sisterhood of Indian Universities, the place occupied by the Punjab University is an honourable one and within a short time the research carried on in her laboratories has earned for her an international reputation to which the Report of the Enquiry Committee amply testifies. If in a university with such a brilliant record of achievements to its credit, the administrative machinery should have given occasion for criticism, the fault is perhaps due to the extensive territorial jurisdiction over which it exercises control. The Punjab University comprehends within its jurisdiction not only the Province of the Punjab but also the North-Western Province, British Baluchistan and some Indian States including Kashmir. The defects inherent in so vast and complex an organisation have unfortunately been magnified by communal schisms which led to the enquiry and we can only hope that the apprehensions entertained by some of the speakers in support of the resolution will be allayed by the recommendations of the Committee about the governance of the University.

A remedy for the universal complaint in our Indian universities, *viz.*, that the high schools do not provide adequate training for their pupils to be able to profit by university instruction is suggested by the Committee, namely, the institution of an Intermediate grade of teaching under the control of an independent Board. This institution is to be formed by the amalgamation of the Intermediate classes and the class X, which is the highest form of the secondary school. The Sadler Commission recommended an Intermediate College of two classes under a similar Board. We have read this section of the Report of the Sadler Commission and that of the Anderson Committee and we can recognise in the recommendation no merit other than novelty. These recommendations are in the nature of experiments and we fail to discover any educational justification in their support. The salvation of the universities is not likely to be achieved by truncating the courses here and augmenting them there, but by the formation of a more rational scheme which will secure the progressive development of all forms of instruction. Every reform of Universities must entail readjustments of the pre-university and secondary schools which in some cases are too ill-adapted to secure for the pupils the literary benefits for which they look forward. We would recommend that the twelve classes which precede the university, be remodelled on the following lines:

1. Primary Schools—four years including elementary grade.
2. Middle Schools—four years instead of three. IV Form of the existing High School be made the final class of these schools.
3. The Pre-university Schools—four years composed of V and VI Forms of the High Schools and the two Intermediate classes.

Many of the defects in the educational system and in the training imparted to the pupils obviously arise from faulty psychological assumptions and maladjustment of the age of the pupils to the standard of instruction to which they address themselves. There is no organising principle in the existing grades of the school system, capable of imparting an air of reality either to the content or the methods of instruction. Our suggestion which seems a radical departure from the existing educational practice, is based on the assumption that a liberal understanding is essential even for an average student and it should be thoroughly obtained by every student before he aspires for the cultural, scientific or professional specialisation of the unversity course. The grades that we have suggested fall into natural divisions in psychological conformity with the ages of scholars and the standards of instructions attempted and they are sufficiently prolonged to give unity of aim and completeness of studies appropriate to the several stages. In any plan of reconstruction the aim ought to be to represent knowledge in its wholeness and not to treat the mind of the pupils in segments, and if no reasonable time is assured for assimilation of knowledge the result must be perfunctory. There is a clear consensus of opinion that the existing grades of instruction are unable to give the pupils the fullest advantage of the educational programme which they set out to fulfil with the result that no one is prepared to assume the responsibility of

imperfections of training. A system of education whose component grades are well articulated may reasonably be expected to provide the necessary time and means for successfully completing a definite programme of work and where such a co-ordination is lacking there is inevitably a tendency for disclaiming the responsibility for work inefficiently performed. Some of the defects of the higher secondary schools arise from the inability of the department to exercise constant vigilance and to render helpful guidance chiefly on account of the increasing number and the variety of schools under its jurisdiction. The Director of Public Instruction, a generation ago, found time to visit the elementary classes and knew enough of educational theory and practice even to teach the little pupils; but to-day the number of schools and pupils is so inflated that a dozen directors will find the task of inspection in the real sense of the word, simply insuperable. Since the progress of education is measured in terms of numbers of schools and pupils, its quality is bound to deteriorate on account of want of effective and periodic supervision and of assistance in the actual day-to-day teaching, apart from all other causes. The redistribution of classes such as we suggest may hopefully be expected to improve the existing unsatisfactory conditions. The first two grades of schools alone need be permitted to remain under the administrative control of the Department and the pre-university or collegiate school should be under the direction of an independent Board such as the one suggested by the Anderson Committee. The independent character of the Board should not, however, preclude it from seeking and establishing opportunities of consulting the university authorities in respect of the prescription of courses of studies and the conduct of examinations, while the inspection of these institutions should be vested solely in the senior members of the university staff. We do not agree with the Sadler Commission in their views that the best interests of the university could be secured by defining the line of demarcation between university and school work at the intermediate stage. A proposal of this nature would imply that the human mind is compartmental and can be taken up in parts for treatment separately and it is this conception of mind that is at the root of all the evils in the domain of education. We are convinced that the educational process must be a continuous effort, the different stages of which should co-operate to achieve the common aim and the transition of one stage to the other must be easy and natural.

(Since writing the above we discovered that the Sadler Commission advocate the creation of a "New type of institution to be called an Intermediate College which should consist of either two intermediate classes or of these and also the two upper classes of the high schools". The latter recommendation appears to us to be the more appropriate one and the compromise suggested by the Anderson Committee is indefensible.)

The removal of the intermediate classes from the University should give it some relief, but no recommendations of a definite character are made by the Enquiry Committee to lighten the strain imposed on it by the extensive territorial jurisdiction which it exercises. Though the terms of reference do not include within their scope an invitation to the Committee to examine and recommend on the prospects of establishing teaching universities in the Punjab, still we obtain a glimpse of their views on this important problem. The claims of Khalsa College are briefly examined for its conversion into an independent unitary university and the Committee content themselves with advising the authorities that "a superior college is infinitely better than an inferior university". The Committee's suggestions in respect of the gradual evolution of independent universities are "a bold policy of higher educational developments in the mufassil" and "a bold constructive plan for mufassil development". The Committee admit that these proposals are vague, but hope that they would be made definite by "the logic of future events" implying "certain principles which if consistently pursued should result in the creation of a number of independent unitary universities".

A great part of the reproach on the governance of the University to which Khan Bahadur Shaikh Din Mahomed and Pir Akbar Ali gave vent in their speeches, is to be attributed to its unwieldy jurisdiction and responsibilities which are too wide and varied to be satisfactorily discharged. The amendments proposed by the Committee in respect of the function of the university in mufassil may not be a relief to its onerous burdens, but definite proposals for the

transformation of certain groups of colleges into constituent units of an independent university would be a more effective and speedy remedy. Having placed the Khalsa College in a category by itself and having recommended "that it should receive special consideration and representation", the Committee would obviously be glad of its elevation into a unitary university. Then it proceeds to lay down certain conditions essential to the well-being of the proposed university and one of these is that "as Khalsa College is situated outside the city of Amritsar, there should be no objection to colleges within the city being connected with another university or authority should they so desire". This option will tend to emphasise the communal character of the Khalsa College the removal of which the Committee urge and it will not strengthen the financial resources of the "potential university". If a number of constituent colleges were to become vital members of this proposed university there is greater likelihood of the Committee's recommendation that it "should not attempt to traverse the whole field of university education" but should "concentrate its energies and resources on a few departments of study, especially those of the professional type" will have some chance of fulfilment. A self-contained or independent university with limited resources should have the means of spreading its faculties over a number of integral colleges instead of concentrating them in one centre. The Khalsa University should be permitted to evolve on its own lines and develop an individuality without becoming complemental. It seems to us that the Sikh community with their enthusiasm for the promotion of higher learning ought to be proud to have a university of their own and, without impairing their cultural traditions, ought to make it sufficiently catholic in its organisation and outlook.

The other recommendations of the Committee are cautious, designed to meet the specific problems falling within the scope of enquiry and their application will probably be found satisfactory. Given the spirit of co-operation and willingness to serve, the province of the Punjab with her great cultural and material resources is bound to become one of foremost centres of learning in India, and her endeavours to augment this distinction will be watched with sympathetic interest by her sister provinces.

Acknowledgment.

WE have pleasure in tendering our warmest thanks to the authorities of the Osmania University for the munificent grant for *Current Science* of Rupees Three Hundred in perpetuity. The Government of H.E.H. The Nizam of Hyderabad has always taken a leading part in the promotion of learning and science and the establishment of Osmania University is intended to preserve and advance Islamic culture in conjunction with Western science. With practically unlimited financial resources of the State and supported by the energetic forward policy of its enlightened ruler, the State and the University, we anticipate, will be able to achieve the happiest results. We shall watch with sympathetic interest the progress of this infant institution.

Further Observations on the Distribution and Associations of *Lantana camara* Linn in Hyderabad (Deccan).

By M. Sayeeduddin, M.A., B.SC., F.R.M.S., *Professor of Botany*, and
Abdus Salaam, B.A., *Osmania University*.

In a previous communication* attention was drawn to the fact that lantana is fast spreading in Hyderabad City and its environs and that it is often to be found along with Cactus (*Opuntia dillenii*). With a view to determine the mode of distribution and association of lantana with Cactus and other plant species, we proceeded to Vikarabad, a distance of 43 miles from Hyderabad, stopping at various places on the way to study the nature of vegetation.

Within 10 miles of the City, we found that in 95 per cent of the cases, lantana was growing amidst Cactus which forms almost a continuous hedge all along the road. In this part of the district the soil is chiefly of the *morum* type which is made up principally of coarse and fine gravel. Between the 10th and the 18th miles, Cactus was almost absent having been destroyed either by the cochineal insect or by fire. From about 15 miles out of Hyderabad, lantana was mostly seen with the spiny shrub, *Gymnosporia montana* of the *Celastraceæ* family. Occasionally these two were also seen in association with *Anona squamosa* Linn. Further on, lantana was found growing with *Dodonæa viscosa* Linn (Sapindaceæ). At different spots lantana had divorced its former associates and was in company with *Butea frondosa* Roxb. and Acacia (sp.?) forming a consociation in which it was dominant. A striking association was met with at a spot about 24 miles from Hyderabad City where lantana, *Gymnosporia montana, Butea frondosa, Tectona grandis, Dodonæa viscosa* and *Gloriosa superba* were all growing together. The last-named plant has been found for the first time on this side, and it may be of interest to note that we found only one within a distance of about 45 miles. As we approached Vikarabad we could see all the hillocks covered with luxuriant growth of lantana which showed all shades of colours—crimson, pink, yellow and white.

In Vikarabad itself lantana had entirely displaced Cactus as a hedge plant.

To obtain a preliminary idea of the distribution of lantana and its associates a representative area of about 2,500 sq. yards was chosen and the vegetation mapped out on a chart. The results showed that lantana is the most prominent form of vegetation

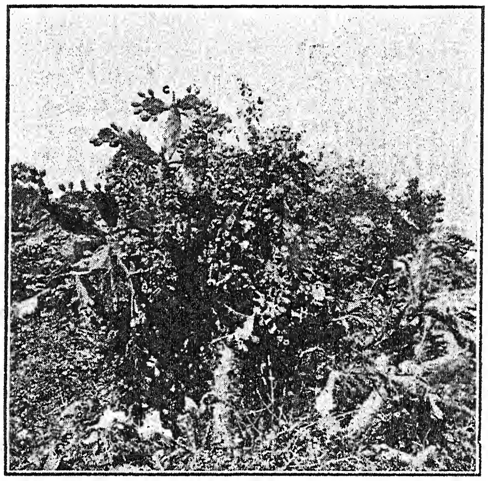

Fig. 1.

Showing Lantana and Cactus growing together.
L—Lantana camara.
C—Cactus (*Opuntia dillenii*).

while *Dodonæa viscosa* and *Zizyphus œnoplia* are next in prominence. A few Acacias and groups of *Gymnosporia montana* are also to be seen. The other forms of vegetation were not seen in any large numbers.

In his paper on "The Hyderabad State Ornithological Survey, Part I" Salim Ali has drawn attention to the fact that bulbuls, mynas, babblers and such like birds visit lantana for its fruit. The observations of the present authors have confirmed the above findings and have shown that birds are chiefly responsible for the rapid spread of lantana. Our studies have shown that many of the birds visiting lantana often follow up with eating the fruits of Cactus. Lantana seeds are thus dropped amidst Cactus bushes so that eventually lantana springs up in the midst of the latter. In regions where Cactus is not prominent, lantana seeds are merely dropped at random by birds as the birds fly from place to place.

* *Curr. Sci.*, **1**, 330, 1933.

Since lantana bush is highly prolific and large numbers of berries are eaten by birds it would follow therefore that the seeds get well disseminated in a very short space of time.

It will be seen from the above that there is a grave danger of lantana rapidly spreading throughout Hyderabad State. The method of destroying the Cactus through the agency of cochineal insect has already been discovered but the problem of eliminating lantana is still awaiting solution.

Biology: its Importance in Modern Education.

By P. W. Gideon, M.A.,

Department of Biology, Karnatak College, Dharwar.

ONE of the most important and remarkable developments of modern times has been in the study of Biology. Educated men have only very recently recognised the fact that this science is in a large sense the foundation of nearly all forms of human progress.

In the past few years vast advances have been made in all the sciences, and in the realm of the Physical Sciences particularly, investigations and discoveries and their practical application to production have resulted in an immense increase of material wealth. This increase, however, is swallowed up by the drain due to the destructive activities of animals and plants which as parasites, carriers of disease germs, and destroyers of crops, are slowly gaining a dominance in the world. Their activities are a menace which unless checked may lead ultimately to the degeneration of the human race. We are awakening to the fact that human efforts in checking this colossal drain on the wealth of nations can only be successful if undertaken on a national basis. A nation's health and efficiency is the health and efficiency of its citizens, and unless this is of a high standard national wealth and prosperity will suffer.

The first step in this great campaign is the education of the general public in the fundamental principles governing life—the laws of health, the functions of the body in health and disease, the chief types of animals and plants beneficial or dangerous to human health, the rôle of animals and plants in the spread of disease and the dangers of uncontrolled human reproduction, especially in the undesirable classes of humanity. Mass ignorance in these respects has undermined the health of nations, incapacitated millions and endangered the health of the fit.

The two main channels for the drain of the world's wealth are through human disease and animal and plant pests, and the progress made hitherto by experts has been almost entirely in the field of cure rather than prevention.

In the problem of disease we have left the task to the medical fraternity. It is impossible for medical men and other scientists alone, with all their knowledge, experience and willingness to serve, to combat disease brought about through ignorance. For every individual cured through the corporate knowledge of doctors and other scientists, there are tens of others who contract disease through that arch enemy, ignorance. The need for more doctors and more money to heal the ever-increasing numbers of suffering humanity will obtain scant relief as long as we fail to change our methods of approaching the problem. A nation's knowledge of the means of preventing disease is probably the biggest and most important step in man's warfare with disease.

In the problem of animal and plant pests similar conditions prevail. Crores of rupees are annually lost in India through the devastating depredations of insects alone. Add to this the wealth lost by other animal and plant pests and the figure far outstrips the wealth that can be accumulated through the combined achievements of all modern science.

The world can never be adequately grateful to the workers in the physical sciences whose achievements and discoveries have contributed much to the progress and prosperity of the world. Admirable as the progress and effect of these achievements may be, the world has not yet found an effective check to the drain of human life and wealth. Indeed we owe it as a tribute to these silent workers to specialise and concentrate on a study of the comparatively neglected Biological Sciences; a knowledge of which is absolutely essential for conserving the health and prosperity that the Physical Sciences have won for us.

Such development in the medical and

economic aspects of Biology may give rise to a new problem—the dangerous increase in human population. Over-production in any commodity is to-day recognised as a major economic problem, and over-production in the human race is perhaps one of the biggest obstacles to human progress. Hence the need for scientific control of human reproduction so that the quality and quantity of human offspring may be such as would promote the health of the race, and as could be supported by the material resources of the country. Unintelligent and uncontrolled reproduction, especially in the undesirable classes of humanity so far, has resulted in a dangerous increase of unwanted and uncared for children, defectives, insane, feeble-minded, habitual criminals and paupers, constituting a big financial burden on the honest citizen and on the nation as a whole. The decrease in the undesirable classes does not necessarily involve the increase of the better stocks. Even legislation will be of no avail unless there is a wide-spread appreciation of the problem; and a study of Social Biology, impressing on man the need for selective breeding so as to eliminate those defects as would hinder man in his struggle for existence, is as imperative as the other aspects of Biology.

The need for the universal study of Biology has been felt in the countries of the West, but the need in India is even more imperative. Even among the literate population of this country how many know that—

(*a*) Malaria, in spite of our knowledge of its cause, means of transmission and methods of prevention, destroys, directly or indirectly, millions of people every year, more or less incapacitates several millions more, and is probably the cause of over one-half the entire mortality of the human race.

(*b*) The average annual cost of Malaria in Bombay City alone exceeds fifty lakhs of rupees.

(*c*) Plague in India takes a toll of several hundred thousand lives every year.

(*d*) Over half a billion people in the world are infected with Hookworm, which feeds on blood from the walls of the intestine, sapping the vitality, poisoning the system, stunting the mental and physical growth of man, and causing that general laziness, stupidity and anæmic condition so characteristic of the Indian labourer.

(*e*) In India a very large proportion of the diseases is due to the wrong habits and customs of the people, coupled with an ignorance of the main sources of contamination; inasmuch as pools, tanks, wells and rivers in India are very important sources of contagion where hundreds of people use unsuspectingly the water for domestic and other purposes, ignorant of the fact that one diseased person could contaminate the whole tank and spread disease to several hundreds of healthy persons.

(*f*) Syphilis is yet one of the principal causes of insanity, paralysis, still-births and barrenness in the civilized world. A great deal of time, money and energy is wasted by well-meaning people in trying to lessen these social diseases by appealing to the higher instincts in man. Admirable as these methods may be, morally, they can only influence the very few, being impracticable in stemming, generally, those urges for which life exists. It is time we recognised human instincts and human cravings as rising even above the highest moral and spiritual instincts man is capable of, and worked for a practical means of solving the problem of disease even through life's strongest urges.

The importance of these diseases is due to their rapid transmission and consequently wide prevalence, and where lakhs of rupees would hardly suffice to merely keep those diseases in check, it would mean an extraordinarily small expenditure to educate the people in the essentials regarding the origin, spread and prevention of these diseases.

There is no doubt that such a dreaded disease as syphilis, which causes untold misery to mankind, is probably one of the easiest diseases to prevent. If humanity were aware that the syphilis spirochæte takes some time to get into the blood stream, and can easily be killed by disinfectants while still on the outer surface of the skin, nine-tenths of human misery and financial loss caused by this disease would disappear. What is true of syphilis is equally true of many diseases, the means of prevention being very simple and requiring only a well organised system of teaching the essentials for living a healthy life in a disease-ridden world.

It is only a thorough knowledge of the dangers of these diseases and a knowledge of the methods of prevention that can materially lessen the terrible destruction to human life and the enormous waste of man's financial resources.

(To be continued.)

History of Science as related to Civilisation.*

By Sir Martin Forster, F.R.S.

IT was indeed a happy inspiration that led Mr. V. Subrahmanya Iyer, former Registrar of the University, to found a periodical celebration of an event so auspicious as the Silver Jubilee of the accession of His Highness the Maharaja, Founder and Chancellor of the Mysore University. I have been honoured by the University Council with an invitation to deliver the sixth of these commemorative lectures, whose declared purpose is to show how the application of scientific methods may " promote soundness of judgment, freshness of outlook and appreciation of higher human values".

On several recent occasions, attention has been directed to the value of the training offered to the non-scientific citizen by the history of science. This movement has its origin in an increasing suspicion that in England the time devoted to laboratory practice in schools is tending to become excessive; and as Indian educational methods are based largely upon Western usage, the growth of opinion which this view involves is deserving of close attention here. More particularly is this the case because the cost of providing laboratory instruction, whether in schools or universities, is very heavy; and at a time like the present, when every item of proposed expenditure, both private and public, demands careful scrutiny, the question whether substantial outlay on materials and appliances really achieves a commensurate benefit becomes important.

Stated otherwise the point is this. Although the current century has witnessed a greatly increasing occupational absorption of men trained in various branches of science, their fraction of those engaged in all employments taken together must remain very small. It is therefore reasonable to ask, is it profitable for the State to provide an expensive form of school-training framed as if all those who receive it were embryo professional scientists? There can be no question that every individual who is privileged to vote should have some knowledge of the fundamental relation of science to the State, but cannot this be conveyed without giving him at the outset a training he might expect to receive if destined to embark on a scientific career?

The basic idea underlying the new movement is that a more generally useful approach to scientific method and scientific ways of thought is the historical one. Every intelligent mind finds attraction in biography, because when faithfully presented this offers the encouraging picture of shortcomings besides virtues, and thus makes us feel more at home even with outstanding personalities. An honest biography levels while it stimulates, and if with these effects the true bearing of science on civilisation be conjoined, this form of instruction can be made most fruitful. It fortunately happens that the history of science, more readily than general history, lends itself to this treatment because its duration, or at least the period of most flourishing development, extends over little more than a century. Consequently its basic facts are more surely ascertainable, many being within the recollection of living people. If this advantage were applicable to general history, much of the rubbish unseasonably uttered about the superiority of the " good old times " would be self-condemned, and much of the discontent prevailing now, as it has prevailed throughout the history of the world, being avoidable, might be avoided.

In designing a course on the history of science appropriate for students who will not for the most part become specialists in science it will be desirable to select the biographies of men whose discoveries may be definitely correlated with improvement in our ways of living and our outlook on life. If examined from this standpoint the whole subject will yield some surprises. Let us take an example that was very much in all our minds two years ago, being the centenary of Michael Faraday's discovery of electro-magnetic induction on 29th August, 1831. It has been claimed that " no other experiment in physical science has been more fruitful in benefit for mankind." All scientific men will agree that the claim is defensible, but the biography of Faraday may be less impressive in a course of science-history for the normal student than

* Sri Krishnarajendra Silver Jubilee Lecture delivered on Saturday, 2nd September 1933.

it is for the professed scientist. Because although his experiments were fundamental, an equally fundamental experiment in the same field had been made by the Danish philosopher Oersted in 1820, he having in that year discovered that a magnetic needle is deflected by a voltaic current; while several other contemporaries of Faraday, notably Arago, Ampère and Humphry Davy were fruitfully engaged in similar studies. In fact, Sir Ambrose Fleming has recorded that "nothing is more remarkable in the history of discovery than the manner in which Ampère seized upon the right clue which enabled him to disentangle the complicated phenomena of electrodynamics and to deduce them all as a consequence of one simple fundamental law, which occupies in electrodynamics the position of the Newtonian law of gravitation in physical astronomy."

To avoid misunderstanding, I must emphasise the point I desire to make, namely, that the transcendent importance of Faraday's work is not so readily appreciable by the normal citizen as by the professional student of science. Although the group of inventions developing the modern dynamo are actually derived from his great discovery that by cutting lines of magnetic force with a conductor, a current of electricity is generated in that conductor, the effect of this discovery on social conditions was long delayed. The modern power-machine, or dynamo, converts mechanical energy into electrical energy, but its development into a form providing cheap and abundant electric light involved numerous factors with which Faraday was not concerned. These depend first on finding the most convenient arrangement of the conductor as related to the magnet, and may be said to have reached their commercial stage in the Gramme-machine of 1870; but they required also those improvements of the arc and the incandescent electric lamp which took place during the ten years following. The scientific men engaged in these developments were very numerous indeed, and therefore, while Faraday's discovery serves to focus the public mind on the benefits accrued, the history of its application is too complicated for general assimilation.

In striking contrast with so devious and highly technical a chapter in science-history are the profound and clear-cut social effects resulting from the discoveries of Pasteur. These originated in a chance appeal for advice from a distiller regarding his fermentation process, which led Pasteur, then Dean of the Faculty of Sciences in Lille, to observe under the microscope that when fermentation was healthy the yeast globules were almost round, but that an acid fermentation was accompanied by elongated cells. This occurred in the summer of 1856, and thereon he wondered whether he might not be confronted with a principle common to all fermentations, namely, that each fermentation arises from its own type of micro-organism.

The consequences of pursuing this idea represent a startling revolution in common thought and in surgical practice throughout the world, because, after a bitter controversy and by methods of experimentation both careful and convincing, Pasteur finally demolished the hypothesis of spontaneous generation. On 7th April, 1864, he concluded a famous lecture at the Sorbonne with these words: "There is now no circumstance known in which it can be affirmed that microscopic beings come into the world without germs, without parents resembling themselves. Those who affirm it have been duped by illusions, by ill-conducted experiments, spoilt by errors that they either did not perceive, or did not know how to avoid."

The fundamental experiments of Pasteur founded the modern science of bacteriology, which he himself did so much to develop until his death in 1895, and their social effect was immediate. The British surgeon Lister had assimilated the idea that infection of surgical wounds—then causing frightful mortality in even the best-conducted hospitals—might be due to the action of living organisms, and beginning in 1864 he proceeded to verify this theory by his aseptic treatment of wounds, using for that purpose carbolic acid. All the antiseptic methods in practice to-day are the direct results of his teaching. It will thus be recognised that for the normal citizen, whose main concern lies in the civilising or socially ameliorating effects of scientific discovery, the biography of Pasteur will be found more impressive than that of Faraday.

For it follows that not only surgery, but general pathology, has profited incalculably and speedily by his work and teaching. While studying anthrax, he introduced the now common method of successive bacterial cultures outside the tissues infected,

and in 1877 elucidated a tangle of observations connected with this venomous disease. About the same time Koch improved that method by adopting solid culture-media in bacteriological technique, in 1882 isolated the tubercle bacillus, and identified the cholera bacillus in the following year. It should now be common knowledge that plague, typhoid, rabies, diphtheria, tetanus and various other pestilences have been very substantially mitigated in consequence of these pioneer investigations, and it will be agreed that the biographies of those patient and courageous men who have provided their fellow-creatures with weapons to combat such fell diseases and thus to preserve many millions of lives, are as worthy of attentive study by the youth of the world as are the biographies of the kings, emperors, generals and ecclesiastics who have destroyed millions.

Social consequences to a scientific discovery of another type cluster round the hydrocarbon benzene. By a coincidence, Faraday figures here also, because he discovered it in oil-gas in 1825; but that chapter in the history of civilisation which might appropriately be called the "Benefits of Benzene" was actually opened by W. H. Perkin in 1856. In this year, while hoping to synthesise quinine, he discovered by accident the artificial colouring-matter, mauve, which paved the way to a vast series of new products contributing inestimably to the comfort, health and æsthetic satisfaction of mankind.

The great impetus given by Perkin to civilisation arose from the fact that he founded, with his own hands, that branch of manufacture known as the organic chemical industry. Prior to 1856, the so-called heavy chemical industry was well established, flourishing predominantly in England. It embraced the large-scale production of acids, alkalis, bleaching-powder and soap, but the colouring-matters, drugs and perfumes then in common use, being all derived from natural sources, were limited and, compared with current prices, costly. When Perkin found mauve to be an excellent dye for silk, he found also that in order to produce it in marketable amounts he would require large quantities of nitrobenzene and aniline, which hitherto had been handled only in the laboratory. Mansfield had just devised the principle, still followed, by which benzene could be obtained commercially from coal-tar naphtha, when the skill and enterprise of Perkin enabled him to produce from benzene on an industrial scale first the nitrobenzene, and thence the aniline required for manufacturing his new artificial dye. He developed this novel industry during the succeeding years, being instrumental in marketing artificial alizarin among other colouring-matters. About 1874, however, competition by factories established on the Rhine a few years earlier, compelled him to dispose of his own factory, to which he could not bring the necessary increased capital, and for which he could not find suitably trained subordinates. Until his death in 1907 he successfully devoted his energies to purely scientific research.

Meanwhile there had sprung into being an entirely new manufacturing technique, the ramifications of which became incredibly wide-spread. A contributory factor of great importance was the prodigal employment of university-trained chemists by the German factories above mentioned, at that time a new principle. The heavy chemical industry itself received a stimulus from the observation that for many purposes the organic chemical industry found fuming sulphuric acid more convenient and efficient than oil of vitriol, and satisfaction of this demand led to an increased interest in catalysis as a principle having wide industrial application, the full effects of which were demonstrated by the European War most disastrously prolonged for three years by its incidence.

Probably the first noticeable result of Perkin's discovery was a multiplication of new dyes and the displacement of madder (since 1868) and of indigo (since 1897) by the corresponding products from coal-tar; but these were only the superficial signs. The outstanding characteristic of the organic chemical industry, distinguishing it from all other industries, lies in the bewildering number of by-products associated with many of its operations. To maintain economic levels of production, uses for these by-products must perforce be found, and the search for remunerative applications has led to the manufacture of numerous new drugs, dyes and photographic materials. This has involved the development of an entirely new, and in some cases very complicated, manufacturing technique, because organic compounds, or the compounds of carbon, require very delicate handling compared with that applied to the materials concerned in the heavy chemical

industry and in metallurgy. This arises from their sensitivity to heat, and the fact that the solvents from which they are crystallised for purification belong to their own class in preference to water. Concurrently, the application of trained minds in rapidly increasing hundreds to the problems involved has given birth to great new industries, such as artificial silk and plastics, or synthetic resins typified by bakelite; besides improving beyond expectation the purification of natural products such as petroleum and sugar.

Another chapter of science-history revealing immediate and far-reaching social results from an accidental discovery is provided by the life of Henry Bessemer. This is admirably described in his autobiography published in 1905, seven years after his death at the age of 85. The three classes of iron known at the middle of the nineteenth century were not then producible in large quantities, and their cost was so high as to preclude their use for many purposes to which they are now freely applied. They were called wrought iron (almost free from carbon), steel (with a medium carbon-content reaching 2·2 per cent.) and cast iron (with increasing amounts of carbon up to 5 per cent.). Wrought iron was too malleable for many purposes, cast iron was too brittle for anything, and steel was found to be greatly hardened by sudden cooling and yet remained malleable on slow cooling. The great contribution to social welfare by Bessemer in 1856 was the discovery that molten cast iron may be deprived of its carbon by a blast of air; and that when thus purified in a suitable converter, iron may be heated easily to a temperature above the melting point of steel. Thus there could be produced in rapidly increasing quantities a new class of iron called mild steel, free from slag, and by early improvements in manufacture almost free from the highly deleterious phosphorus and sulphur.

The results of this discovery during the succeeding fifty years have been magical, because the abundance and improved quality of steel produced in England and the United States led to its adoption for constructional purposes of every kind, while the consequent facility with which other metals, notably manganese, nickel, chromium and tungsten may be added in amounts producing remarkable and convenient changes in the properties of steel has led to an enormously expanded variety of application. The machine-shop in particular has benefited by one of these in the shape of high-speed steel, containing quite large percentages of chromium and tungsten, which by causing the steel to retain its hardness at elevated temperatures enables a cutting-tool to be used in the lathe at greatly increased speeds. Thus the advantage to engineering practice has been incalculable.

The foregoing examples of science-history within reach of the normal citizen, and illustrating how his comfort and security have been augmented by scientific investigation, relate to periods just beyond the life-time of the present generation, but one which will naturally occur to many present as having taken place under their own eyes will be found in the principle of internal combustion, to which is due the tremendous development of motor-traffic. This hinges on consuming the fuel within the motive power-cylinder instead of outside, as in the steam-engine, and began with the Otto gas-engine of 1876, still used for stationary purposes. Extension of this principle to an internal combustion motor using petroleum vapour instead of coal-gas, effected by Daimler in 1885, was the first step towards the complete revolution in road transport witnessed by the present generation, accomplished by constant improvement in mechanical details of the engine, in the method of igniting the explosive mixture of petroleum vapour with air, in lubrication and in the character and quality of tires for the wheels.

Concurrently with this revolution has proceeded a revolution in the oil and rubber industries. The United States petroleum industry began in 1859 with the discovery of rock-oil in Pennsylvania, and rapidly grew to enormous proportions, products from the fractional distillation being universally adopted for heating, lighting and lubrication. The transformation of this industry due to the multiplication of motor-vehicles is two-fold, firstly in the methods of purification and distillation, secondly in the practice of cracking, the process by which fractions of high boiling point may be converted into motor-spirit. A third phase in this transformation now impending, is the production of oil by the hydrogenation of coal and coal-tar. This phase is at the development stage, but in the last few weeks a conditional remission of petrol tax by the British Government has led the Chairman of

Imperial Chemical Industries to announce that his company will proceed with a plant for hydrogenating coal at an outlay of $2\frac{1}{2}$ million pounds : this follows an expenditure of one million pounds on the preliminary experiments.

It must be remembered that crude petroleum is a very complicated mixture of chemical individuals, ranging from gases of the methane type through the diminishingly volatile hydrocarbons of the paraffin series to low-melting solids like vaseline. The composition of these mixtures varies greatly with geographical origin, Borneo petroleum, for instance, being rich in benzenoid hydrocarbons. Before the more volatile fraction called petrol, or gasoline in the United States, was applied to motive internal combustion engines, it was a dangerous component of the illuminating fraction, and went largely to waste. For many years past, however, all the ingenuity of the manufacturer has been directed to conserving this volatile fraction, increasing its supply and producing it in a more highly purified condition. The demand for motor-spirit has led to these vast improvements in manufacture and to the introduction of cracking, while the resultant purity of the more volatile fraction has been an important factor in the development and multiplication of air-craft. A moment's reflection on the colossal advantages arising from the growth of motor-traffic in this country will convince you of the beneficent relation borne by scientific discovery and invention to the State, particularly as this demonstration has progressed under your own eyes.

Another revolution still in progress relates to the preservation and transport of food as effected by canning and refrigeration. Although having less practical interest for the people of this country than for Europeans and Americans, whose customary diet has been vastly improved and varied by these processes, it nevertheless will benefit indirectly the population of India because it has developed a food-science, including recognition of the vitamin principle and a more scientific evaluation of nutritional factors, which cannot fail ultimately to improve the public health. The speed of development and widening scope of this new knowledge form a separate chapter of science-history, but an illuminating example is given by the history of solid carbon dioxide, known as Dry Ice in the States and Drikold or Cardice in England, in which countries it is now increasingly used as a refrigerant. The commercial production of this material began only in 1924, and the manufacturing tonnage for the United States is as follows :— 1925, 170 ; 1926, 525 ; 1927, 1,715 ; 1928, 7,000 ; 1929, 22,000 ; 1930, 40,000.

Enough has now been said to demonstrate the very direct bearing on our individual modes of living effected in recent years by scientific discovery and invention ; and to show that in many cases this may be recognised and traced by the normal citizen untrained in scientific practice. Many other examples will occur to your minds, such as line and wireless telegraphy and telephony, motion-pictures, hydro-electric power generation and non-ferrous metallurgy. A distinct, but very important section of science-history lies in the realm of ideas as a stimulus to experiment. This may be illustrated by the theory of evolution as taught by Darwin and his followers ; the cell-theory as developed by Schleiden for plants (1838) and by Schwann for animal tissue (1839) ; and finally, the conception of the atom as formulated by Dalton and replaced in very recent years by the captivating theories of Rutherford and Bohr.

The conclusion that I now submit is this. If civilisation be defined as reclamation from barbarism, as a process of developing the arts and refinements of life, no century in the world's history has been more fruitful in civilising agency than the last hundred years. In that period have been recorded unhappily the average number of human conflicts, political and martial, differing only in their weapons and their staging from the ceaseless human discords common to general history. On this murky background, however, has been painted with radiant brush the promise of a colourful era which the nations may enter when they unite in recognising political quarrels to be less advantageous than the co-operative harvesting of Nature's gifts as a consequence to elucidation of natural laws. This desirable step towards popular enlightenment would be hastened if the more fundamental of these laws, and the history of their application to modern progress, were allowed increasingly to replace general history in the school curricula, so that the changes now rapidly transforming the art of living may be brought into proper perspective and healthily developed.

Prominent in the study of these changes must be the life-history of the people most concerned in them. The lesson from all these lives, for all of us, is their thoroughness and beneficence. If half the attention of schools, colleges and mature citizens that has been given to Alexander, Cæsar and Napoleon had been devoted to Faraday, Pasteur, Lister and Bessemer, the world would be a different and a better world to-day. Because, not only were these men remarkable discoverers, to whom we owe far greater security and amenity of life than our forefathers could enjoy, but their methods of work and their outlook towards their fellow-beings display just those qualities most needed for smooth and continued progress of civilisation: patience, honesty and thoroughness in their labour combined with inexhaustible goodwill towards mankind.

Letters to the Editor.

On the Discovery of *Prothallus* in Indian *Ophioglossums*.

THE genus *Ophioglossum* has interested a number of botanists in India and abroad on account of its peculiar systematic position in the Pteridophyta. Attempts are often being made to throw more light upon its life-history simply by the study of the sporophyte generation. But the gametophyte generation has not been so well studied owing to several difficulties in its way. It is, however, to be noted with satisfaction that it was studied in a few species of *Ophioglossum* during the latter half of the last century and in the beginning of the present century by some eminent workers. Mettenius, for instance, studied *O. pedunculosum* as far back as 1856, while Dr. Lang studied prothalli of *O. pendulum* in 1902; and Bruchmann studied the *Ophioglossum vulgatum* in 1904. Later on Dr. Campbell confirmed the results of these authors by his study on *O. moluccanum* and *O. pendulum* in 1906. Since then no attempts appear to have been made either by way of confirmation of old results or by way of investigation of new ones.

It was in 1930 that my attention was drawn to this subject by some remarks on *Ophioglossum* made by Prof. Dixit in his book and I began to study it, more critically since 1931. My observations by the cultural methods—later on confirmed by the gametophytes that I could obtain in nature—I have been able to discover the prothalli of some four Indian species which appear to be different from those that have been studied by previous botanists such as Dr. Lang and others.

The peculiar methods used in obtaining them have been summarised in my "*Rationale* of the germination of the spores in *Ophioglossum*" which will soon appear elsewhere.

My further researches on this structure have given me a wealth of new facts and allowed me to throw a good deal of light on some previously unsolved points. It was very kind of Prof. Dixit to confirm my results later and I offer my sincere thanks to him and to my two colleagues Messrs. Deshpande and Kanitkar.

T. S. MAHABALE.

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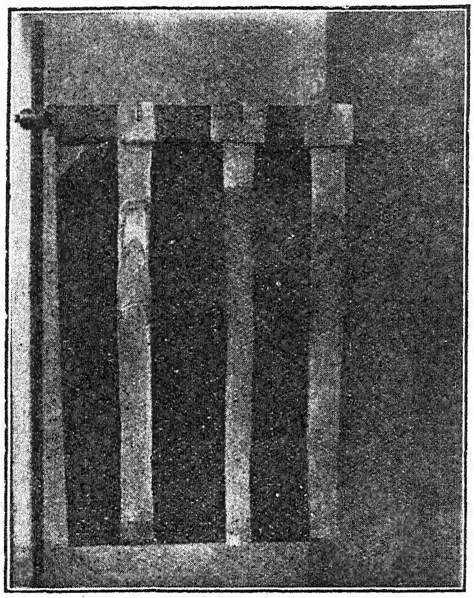
Poona (4),
August 15, 1933.

Theory of Parallel Deposits of Solute by Evaporation from the Walls.

D. OWEN before the Physical Society of London, 22nd May 1932, gave a demonstration of the difference of heights to which (1) fuchsin, (2) salt solution, and (3) a mixture of the two solutions respectively would rise in a strip of filter paper dipping into these solutions.

In repeating the experiment, we noted the formation of very beautiful parallel deposits. One of us, in a paper on the variability of Avogadro's Number (S. Ray in *Zeit.f.phys. Chemie*, **128**, 186, 1927) has shown that in a solution or sol the concentration variation with height follows a curve as in Fig. 1 while in another paper on A Physical Factor in Liesegang Phenomenon (*Koll. Zeit.*, **44**, 277, 1928) the same author has shown that this concentration distribution has the possibility of explaining Liesegang phenomena. Thus, if in the graph, AB is a line parallel to OY, the Y axis, such that tangent at C is parallel to the tangent at D, it means at these two points not only are

the concentrations identical but also concentration *gradient*. The appearance of the graph of concentration on the OY axis is



very much like that of half dome resting on half a pillar, or in other words it is a vertical longitudinal section through a dome resting on a pillar.

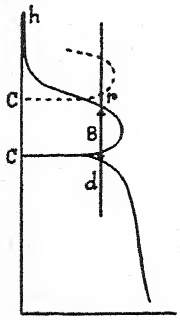


Fig. 1.

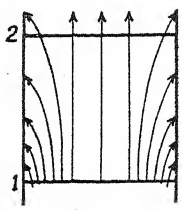


Fig. 2.

In our graph, C is in the pillar region and D in the "dome". This distribution, however, is true only for a column in *equilibrium* at the same temperature throughout. Now in a rise (or descent) of a liquid, a static equilibrium at constant temperature is not obtained, but we have a dynamical process with difference of temperature along the column of which the article mentioned above on Variability of Avogadro's Number takes no cognisance. If therefore in a rise from the bottom at D, the conditions of temperature, pressure, etc., make themselves identical with that at C, then it stands to reason that in the "dome" region, at D the reaction will proceed as it had at C in the "pillar" region, and instead of proceeding to the point of the spire will proceed towards C′, and the "wavelength" $\alpha\gamma$ will repeat itself. (This viewpoint was communicated to Dr. R. Liesegang and accepted by him.)

We have in Fig. 2 a section through the thickness of the blotting paper.

Obviously, evaporation is continuously taking place all the time, the solution, and the solute is being carried upwards. Using the well-known equation* of electric and thermal conductivity or diffusion of particles having gravitational mass, the mass of salt dq, going up across the section 1, is

$$dq_1 = -\mathrm{KA}\left(\frac{dc}{dx}\right)_1 dt$$

where c is the concentration, whilst going across the section 2,

$$dq_2 = -\mathrm{KA}\left(\frac{dc}{dx}\right)_2 dt$$

then dq_2 is less than dq_1. The difference $(dq_1 - dq_2)$ gets deposited on the face of the blotting paper. The expression for this deposit is

$$(dq_1 - dq_2) = \mathrm{KA}\left(\frac{d^2c}{dx^2}\right)\delta x \cdot dt \quad \ldots\ldots (1)$$

where δx is the distance apart between sections 1 and 2.

Now we proceed to find another, independent, mathematical expression for this *surface* deposit. The deposit will depend upon the rate of evaporation. This will depend upon the surface evaporating and upon the humidity of the atmosphere. Or

$$\delta q \propto p\ \delta x . \phi(h)$$

$\phi(h)$ shows variation of evaporation upon "humidity" and p is the perimeter of the cross section. Also the rate of deposit will depend upon the concentration at the height concerned which settles the vapour pressure, or

$$\delta q \propto f(c).$$

Combining the two variabilities in a single equation

$$\delta q = a.p\ \delta x . f(c) .\ \phi(h) dt \quad \ldots\ldots\ldots (2)$$

where a is the constant of proportionality.

Now to a first approximation, by Raoult's Law, we can assume

$$f(c) = (1 - kc).$$

We can also, in analogy to Newton's Law of Cooling, assume

$$\phi(h) = k_2(h_0 - h)$$

where h_0 is the absolute humidity required

* See "Das Ohm-Fouriersche Gesetz der Leitung," *Zeit. f. Electrochemie,* 753, 1928.

for saturating the atmosphere. Therefore our equation becomes:—

$$KA\left(\frac{d^2c}{dl^2}\right)\delta x.dt = a\,p.\delta x(1-kc).\,k_2(h_\circ-h)dt \,. \quad (3)$$

which may be written

$$\frac{d^2c}{dx^2}=\beta^2(1-kc), \text{ where } \beta^2=\frac{a\,p.k_2.(h_\circ-h)}{KA}$$

The solution of the equation is

$$(1-kc)=a\sin(\beta\sqrt{k}.x+\gamma) \text{ or}$$

$$c=\frac{1}{k}\left\{1-a\sin(\beta\sqrt{k}\,x+\gamma)\right\} \quad \ldots \quad (4)$$

So that the concentration is varying periodically with height, the wavelength being given by

$$\lambda=\frac{2\pi}{\beta\sqrt{k}}=\frac{2\pi}{\sqrt{k}}\sqrt{\frac{KA}{apk_2(h_\circ-h)}} \quad \ldots \quad (5)$$

Experiments to test this formula are in progress. On the face of it, it has the capacity of explaining some well-known facts in these as well as Liesegang Deposits. Thus, $\sqrt{k}$ in the denominator in (5) would make the deposits closer with more concentrated solutions. The increase with A and decrease with $(h_\circ-h)$ of the wave-length has also been qualitatively proved.

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August 19, 1933.

Formaldehyde-yielding Complex in the Lignin Molecule.

RAW jute freed from fatty and resinous matter as well as other impurities gives on distillation with 12 per cent HCl according to Tollen's method a distillate which contains both furfural and formaldehyde. The former is detected by aniline acetate paper which remains unchanged by formaldehyde, and the latter by Schryver's reagent after much dilution. In very dilute solution furfural does not interfere with the test for formaldehyde.

Jute after complete removal of lignin by moist ClO_2 gas gives furfural but no formaldehyde. Lignin obtained by 72 per cent H_2SO_4 or by Willstätter's method gives formaldehyde but no furfural. It has been shown from this laboratory that ClO_2 removes nothing but lignin from jute. Hence, lignin from jute is free from furfural but contains a formaldehyde-yielding complex. This supports the view of Freudenberg[1] that lignin contains a dioxymethylene group which is responsible for the formaldehyde.

Raw bamboo similarly treated gives formaldehyde but not de-lignified bamboo. Packing box wood also behaves similarly. Phillips and Goss[1] obtained HCHO from lignin prepared by Urban's method only. So far as jute is concerned, this is not substantially correct.

PULIN BEHARI SARKAR.
Chemical Laboratory,
Dacca University,
August 20, 1933.

[1] *Ber.*, **60**, 581, 1927.

[1] *J. Am. Chem. Soc.*, p. 3374, 1932.

Absorption Effects in the Total Secondary Electron Emission from Metal Faces.

Two outstanding problems in the study of total secondary electron emission from metal faces are the peculiar shape of the total emission curves and the differences observed between polycrystalline and single crystal faces.[2] No explanations have so far been offered to account for these observations.

It is well known that the mean velocity of the secondary electrons increases as the applied potential is raised, rapidly at low and more slowly at high potentials. We can now explain the above results making a few simple assumptions which do not in any manner violate the principles involved in the mechanism of secondary emission. Assuming that the secondary electrons are produced at a mean depth within the surface of the target (this depth varying directly as the applied potential V and inversely as α the coefficient of absorption of the primary electrons, the constant of variation being B), and suffer absorption in travelling outwards (this coefficient being taken as β), we can show by a simple calculation that R (the ratio of the total secondary to the primary current) $=AV\,e^{-(1+\beta/\alpha)BV}$. This leads to the conclusion that we should get straight line curves if we plot points between $\log_{10}\frac{R}{V}$ and V, the slope being $\frac{-(1+\beta/\alpha)}{2\cdot3026}$ B.

The results of Petry[3] and the writer[2] are found to give such straight line curves except at potentials less than about 250 volts in which range β decreases somewhat rapidly as V is increased. The differences

[2] S. R. Rao, *Proc. Roy. Soc.*, **A 128**, 41, 1930.

[3] R. L. Petry, *Phys. Rev.*, **26**, 346, 1925 and **28**, 362, 1926.

between the R values of polycrystalline and single metal faces may be attributed to different B values for these faces since it is normal to expect different depths of penetration with different crystal faces, other conditions remaining the same. When the first few layers are concerned this may not be significant and this is exactly what is observed, the R values being the same at about 50 volts. The above considerations enable us also to give a natural explanation for the differences observed between gas covered and perfectly degassed metal faces.

Full details will be published elsewhere.

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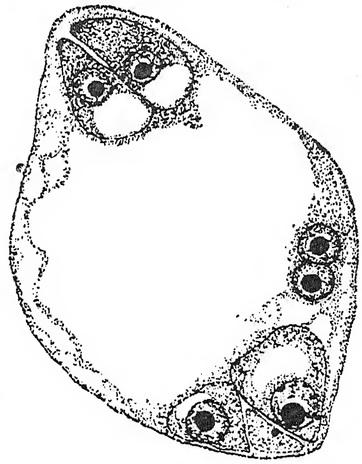
August 22, 1933.

The Development of the Female Gametophyte and Chromosome Number of *Argemone mexicana* Linn.

INVESTIGATIONS on the morphology and cytology of *Argemone mexicana* have been in progress in this laboratory since the last two years and the work is now nearing completion. In a recent paper Joshi[1] has given an account of the formation of megaspores and embryo-sac in this plant. His account which is based on material obtained from only 'two ovaries' differs in certain fundamental points from our observations. In this note an outline of the development of the female gametophyte as observed by us is presented.

Joshi presumes that the archesporial cell is hypodermal in origin and this by transverse division gives rise to a 'wall cell' and the megaspore mother cell. Our observations support his statement. By the division of the megaspore mother cell a dyad is produced and the two cells of the dyad as a rule divide periclinally and produce a normal linear tetrad. The 'T-shaped' tetrad which according to Joshi is a characteristic feature of this plant, is of comparatively rare occurrence. Generally the upper three megaspores from the micropylar end degenerate and the chalazal one functions. It increases in size before division and by three successive divisions produces an eight nucleate embryo-sac. The structure of the fully differentiated embryo-sac is given below:



× 550.

It will be noted that the synergids are nearly as big as the antipodals. The egg is situated centrally between the synergids and is masked by them. The two polar nuclei lie very close to each other before fusion. The approximate sizes of the synergids, the egg, the polar nuclei and the antipodals at this stage are given below:

Synergid	..	28·6 μ
Egg	..	22·0 μ
Polar nucleus	..	8·8 μ
Antipodal cell	..	26·4 μ

Endosperm formation commences very soon after fertilisation. The synergids are not observed at this stage, but the antipodal cells increase very considerably in size. The average dimension of an antipodal cell when the endosperm nuclei form a lining around the nucellar cavity is 154μ. Signs of degeneration of the antipodals are just apparent at this stage. It thus appears that the antipodal cells of Argemone behave similarly to that observed by Huss[2] in *Fumaria*, *Corydalis* and *Papaver*.

The chromosome number of *Argemone mexicana* has been computed from the meiotic stages of the microspore mother cells and it has been found to be fourteen (n=14).

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I. BANERJI.
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Calcutta University,
August 24, 1933.

[1] Joshi, A. C., "Megaspore formation and Embryo-sac of *Argemone mexicana*, Linn," *The Jr. of the Indian Botanical Soc.*, **12**, No. 2, April 1933.

[2] Huss, G. A., "Beitrage zur Morphologie und Physiologie der Antipoden," *Beih. Bot. Centralb.*, **20**, 77-174, 1906.

Oil-Soluble Vitamin A in Some Pulses and Fishes of Bengal.

THE importance of accessory food factors—enzymes and vitamins—is well recognised. Cod liver oil, owing to its A vitamin content, commands a world-wide reputation. However, other fish oils, such as Halibut, are being discovered with nearly sixty times the potency of cod liver oil. Amongst the Bengal fishes Hilsha (*Clupea ilisha*), Rohit (*Labeo rohita*) and Catla (*Catla catla*) are in daily use. Body, roe and liver fats of these fishes had been studied at the Bose Research Institute Laboratories and referred to in the abstracts published in the *Proceedings of the Indian Science Congress.*[1]

Vegetable oils are generally classed as "bad fats"[2] and classed with lard, which last is used in physiological control experiments. At the Bose Research Institute, Bengal, pulses have been the subject of investigation from various points of view; certain special qualities of *Cicer arietinum* have been reported in the Transactions of the Bose Institute.[3] Particular attention was drawn to the presence of carotene and its significance to vitamin A. Lovibond Tintometric measurements showed *Cicer arietinum* oil to approach cod liver oil of approved quality. Spectroscopic examination of the $SbCl_3$ blue compound also confirmed this significance[1]. Photographs taken of the spectra show absorption bands at about 610—625 μ, 570—580 μ and 540—550 μ, corresponding to those obtained with cod liver oil.[4] The specificity of the band at or about 620 μ is now well recognised. Hilsha fish liver oil gives a band at 500 μ, which is very pronounced; the other bands are rather broad and often merge one into the others.

The subject is being further studied in its various aspects as regards keeping quality and potency. Hilsha fish oil shows variation with season, and whether the fish is roe-bearing or not. In some Tintometric measurements, the figures were as high as those of halibut oil or even higher.

Physiological observations with rats have given very promising results with *Cicer arietinum* oil. Its importance will be easily appreciated when it is remembered that Lovibond Tintometric figures for this *vegetable* oil approach closely those of cod liver oil.

Fuller details with spectrographs will be published in due course in the *Transactions of the Bose Research Institute.*

N. C. NAG.
H. N. BANERJEE.

Bose Research Institute,
Calcutta,
August 25, 1933.

[1] Banerjee and Nag, *Proc. Ind. Sci. Congress*, XX, Chem., No. 192.

[2] Plimmer and Plimmer, *Food, Health, Vitamins*, p. 60, Longmans, Green & Co., 1932.

[3] Banerjee, "Chemical Examination of Oils from Leguminous Pulses," *Trans. Bose. Inst.*, VII, 1931-32.

Nag and Banerjee, *Proc. Ind. Sci. Congress*, XIX, 1932, Chem., No. 211, p. 244.

[4] "Communications from the Universities of Zurich and Utrecht," *Nature*, July 1st and July 29th, 1933.

A Note on the "New Type of Fertilization" in Plants.

VARIATION from the generally accepted view that during double fertilization in plants the primary endosperm-nucleus becomes triploid and contains 3x number of chromosomes was first reported by Ferguson.[1] She found that due to the premature division of the primary endosperm-nucleus before the discharge of the sperms from the pollen tube, one-fourth of the endosperm tissue (which is derived from the fertilized micropylar endosperm-nucleus) becomes triploid whereas the remaining three-fourths (which is derived from the unfertilized chalazal endosperm-nucleus) remains diploid. During my investigation on the embryology of some members of Solanaceæ, I have also observed this new type of double fertilization in one of the strains of 'Tomato' grown in the college experimental grounds. Here also the two polar nuclei fuse before the opening of the flower and divide as a rule before the discharge of the sperms from the pollen tube forming a small micropylar and a big chalazal endosperm cell. Fig. 1 will show that the primary endosperm nucleus has divided while the two sperms are still seen inside the pollen tube.

After the discharge of the sperms into the embryo-sac, one sperm fuses with the egg and the other with the micropylar endosperm-nucleus. The chalazal nucleus, however, divides and forms part of the

[1] Ferguson, M. C., *Bull. Torr. Bot. Club*, **64**, 657-664, 1927.

endosperm tissue which remains diploid. During the first division of the primary endosperm-nucleus approximately 24 chromosomes were counted instead of 36, the haploid number determined for the species

Fig. 1.

Microphotograph showing the micropylar and the chalazal endosperm cells and the two sperms inside the pollen tube.

p.e. Position of the egg, not in focus.
sp. Sperm.
mi.c. Micropylar endosperm cell.
ch.c. Chalazal endosperm cell.

being 12. This shows that the primary endosperm-nucleus is diploid (not triploid) at the time of first divison and the division takes place before fusion with the second male nucleus. It, therefore, seems to be very probable that Cooper[2] has either overlooked the chalazal endosperm-nucleus or the same was missed owing to the section being oblique. A detailed account of the observation, will shortly be published elsewhere.

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Calcutta University,
August 25, 1933.

The Quantum Statistical Theory of Fluctuation.

IN an interesting paper in *Phys. Rev.*, **21**, 672 (1923) Kar has derived some important classical relations between the different partial fluctuations, and with the help of these, and two independently derived partial fluctuations, obtained all other fluctuations. I have been able to generalise these partial relations with the help of quantum statistics (Bose-Einstein and Fermi). They are, in their usual notations,

$$\left.\begin{aligned}
\overline{(\delta^2{}_p)_T} &= \overline{(\delta^2{}_v)_T}\,(1 \mp y),\\
\overline{(\delta^2{}_T)_p} &= \overline{(\delta^2{}_v)_p}\,(1 \mp \tfrac{5}{2}y),\\
\overline{(\delta^2{}_T)_v} &= \overline{(\delta^2{}_p)_v}\,(1 \mp \tfrac{3}{2}y),\\
\overline{(\delta^2{}_E)_y} &= \overline{(\delta^2{}_p)_y},\\
\overline{(\delta^2{}_E)_T} &= \overline{(\delta^2{}_V)_T}\cdot\tfrac{1}{4}y^2,\\
\text{where } y &= \frac{N}{V}\cdot\frac{h^3}{(4\pi mkT)^{3/2}},
\end{aligned}\right\}\ \text{Non-degenerate (1)}$$

and

$$\left.\begin{aligned}
\overline{(\delta^2{}_p)_T} &= \overline{(\delta^2{}_v)_T}\cdot\tfrac{25}{9}\,(1 \pm 8c_2/z^2),\\
\left(\frac{10c_2}{z^2}\right)^2\overline{(\delta^2{}_T)_p} &= (\delta^2{}_v)_p\cdot\tfrac{25}{9}\,(1 \pm 8c_2/z^2),\\
\left(\frac{10c_2}{z^2}\right)^2\overline{(\delta^2{}_T)_v} &= (\delta^2{}_p)_v = (\delta^2{}_E)_E,\\
\text{where } z &= \left(\frac{3N}{4\pi v}\right)^{2/3}\frac{h^2}{(2mkT)^2},
\end{aligned}\right\}\ \text{Degenerate (2)}$$

and $c_2 = \pi^2/6$ (Bose), $= \pi^2/12$ (Fermi)

where the upper sign is for Bose-Einstein statistics and the lower for Fermi. It is noteworthy that neglecting the higher correction in the non-degenerate case one gets the well-known relations of Kar.

In order to get the value of any fluctuation we must know in addition to the above relations at least two partial fluctuations. The quantum statistical values of these as obtained by me are :—

$$\left.\begin{aligned}
\overline{(\delta^2{}_E)_v} &= \frac{2}{3N}\,(1 \pm \tfrac{5}{8}y)\\
\overline{(\delta^2{}_v)_T} &= \frac{1}{N}\,(1 \pm \cdot 647y)
\end{aligned}\right\}\text{Non-degenerate (3)}$$

$$\left.\begin{aligned}
\overline{(\delta^2{}_E)_v} &= \frac{4}{21N}\,(1 \mp 25c_2/z^2)\\
\overline{(\delta^2{}_v)_T} &= \frac{1}{2N}\,(1 \mp 6c_2/z^2)
\end{aligned}\right\}\text{Degenerate (4)}$$

One readily gets from (1) and (3) for the non-degenerate state

$$\left.\begin{aligned}
\overline{(\delta^2{}_T)_v} &= \frac{2}{3N}\,(1 \mp \cdot 875y)\\
\overline{(\delta^2{}_p)} &= \frac{5}{3N}\,(1 \mp \cdot 038y)
\end{aligned}\right\}\ \ldots\ldots\ldots (5)$$

and from (2) and (4) for the degenerate state

$$\left.\begin{aligned}
\overline{(\delta^2{}_T)_v} &= \frac{4}{21N}\left(\frac{z^2}{10c_2}\right)^2(1 \mp 25c_2/z^2)\\
(\delta^2{}_p) &= \frac{19}{6N}\,(1 \mp 3\cdot 7c_2/z^2)
\end{aligned}\right\}\ \ldots (6)$$

In the above I have more or less quoted the results recently obtained, which are all claimed to be new.

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[2] Cooper, D. C., *Amer. Jour. Bot.*, **18**, 739–748, 1931.

Full details of the investigations will be published elsewhere.

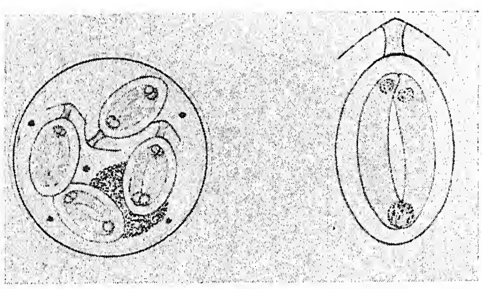
M. GHOSH.

Physical Research Laboratory,
Presidency College,
Calcutta,
August, 1933.

Fish Coccidia.

Two unique types of Eimera, hitherto not recorded, were found during investigation on Coccidia by Miss R. H. Bana, a student preparing under me for the M.Sc. degree. She has also discovered and worked out the complete life-cycle of a new species of Isospora from Calotes versicolor. A brief résumé of the main features of each is given below.

One of the Eimera referred to above and hitherto not recorded, was found in the alimentary canal of a fish popularly known as Bombay Duck (*Harpodon nehereus*) *vide* illustration. Each sporocyst in this species is elliptical in outline with the end towards the narrow side of the oval projecting in the form of a neck. At the edge of this protuberance or neck is a broad inverted V-shaped appendage which is clearly visible both in the living and stained preparations. A sporocystic residue is also usually present. The oocysts are often almost spherical and have a diameter of about 12μ.



Oocyst and Sporocysts from *Harpodon nehereus.*

Reptilian Coccidia.

(A) EIMERA FROM HEMIDACTYLUS SP.

The host is usually obtained on exterior walls of buildings. It is probably *Hemidactylus flaviviridis*. The parasite which was found in the gall bladder is undoubtedly a species of Eimera. So far Eimera have usually been met with in the intestine, liver and kidney of their hosts. The present find is therefore unique despite the only species of Eimera (*E. utinensis*) in the lungs and gall bladder of a horse in Italy by Salen and Vittoria (1924). Of their discovery Wenyon (1926) says that the description and figures are so unsatisfactory that it is impossible to form an opinion of the nature of the structures depicted.

The uniqueness of the present find lies in that all the developmental stages are completed in the columnar cells of the gall bladder. The ripe oocysts measure 24μ by 34μ in length and 11μ by 14μ in breadth. The sporocysts measure 9μ by 7μ.

Eimera from *H. flaviviridis.*

(B) ISOSPORA SP. FROM CALOTES VERSICOLOR.

A new species of Isospora, which infects the intestine of the lizard, has been found. The complete life-cycle of the parasite has been worked out.

The developmental stages of the parasite are very simple and in many respects follow those of *Isospora felis* (Wenyon). Their chief interest lies in the apparent clearness of their developmental stages and the intensity of infection, the number of infected lizards being as large as 80 per cent. The importance of this find lies in the abundant facilities such Isospora provide for class work, as calotes are freely distributed all over the country.

A critical study of the parasite has been made and the detailed results of the investigation will be duly published.

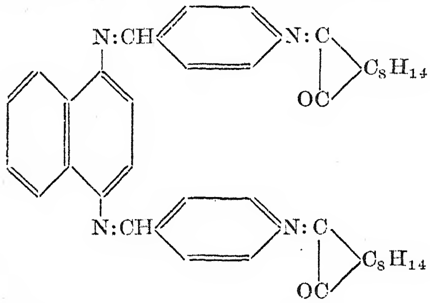
S. B. SETNA.

Royal Institute of Science,
Bombay,
August 28, 1933.

Bisiminocamphor Derivatives with Exalted Optical Activity.

FORSTER and Thornley (*J. C. S.*, **95**, 942, 1909) observed that bisiminocamphor derivatives display remarkably high rotatory power, and this was later ascribed to an optimum association of azethenoid groups, conjugated linkages and a benzene ring within a narrow molecular compass (Forster and Spinner, *ibid.*, **115**, 889, 1919). B. K. Singh and his collaborators have prepared

1 : 4-naphthylenebisiminocamphor and *pp'*-bisiminocamphordiphenylamine, with molecular rotations 13416° (pyridine) and 14231° (ethyl alcohol), respectively. These two compounds were known so far to possess the highest molecular rotation. We have now prepared 1 : 4-naphthylenebisiminobenzylideneiminocamphor,



in which the number of conjugated double linkages has been increased to seventeen; and the molecular rotation reaches 22050° in pyridine for the mercury yellow line, 5780. This compound has been obtained by condensing *p*-acetaminobenzaldehyde with 1: 4-naphthylenediamine, removing the acetyl groups by dilute hydrochloric acid in alcohol, and condensing the resulting bisaminobenzylidenenaphthylenediamine with camphorquinone

The bisiminocamphor derivatives of *pp*-diaminodiphenylcarbamide and *pp*-diaminodiphenyloxamide show molecular rotations 8911° and 12094° respectively in chloroform.

P. C. GUHA.
S. M. PATEL.

Indian Institute of Science,
Bangalore,
August 28, 1933.

Physiology of the Stink-glands of the Millipede, *Thyropygus malayus*.

THE stink-glands or the *Glandulæ odoriferæ* are of common occurrence in millipedes. The work that has been done on the physiology of these glands is summarised in Kukenthal's *Handbuch der Zoologie*, Band IV (1926-28). The chief substances of physiological interest in the secretion of these glands mentioned are Prussic acid, Iodine and Quinine. The presence of *Chlorine* is so far unknown in these glands but I have been able to demonstrate its occurrence now in the secretion of the stink-glands of *Thyropygus malayus*.

The main facts as studied in *Thyropygus malayus* are as follows :—

The glands are situated on the lateral walls of the chitinous body rings as sac-like structures consisting of a bladder-like vesicle and a protruding tubular channel with a regulating lid near its opening. The glands open to the exterior by longitudinal slits, the *Foramina repugnatoria*. The first seventeen pairs of glands are small and have smaller openings but those situated behind are comparatively bigger and have larger openings as well. The glands are, however, absent from the first five segments of the body including the Collum, as well as from the last or anal segment. A yellowish, pungent fluid constantly oozes out of the *Foramina repugnatoria*, but when irritated the millipedes pour out considerable quantities of this offensive secretion. Each gland has got its own blood and nerve supply.

The yellow and oily secretion of the glands is readily miscible with water imparting a yellow colour to the solution which on standing turns brown. When dried the secretion forms dark black shining flakes. The odour of the secretion is very pungent with a faint smell of bitter almonds, which becomes very characteristic when the solution stands for some time. This pungent odour according to my experimental evidence, is due to *Chlorine* which mars the smell of bitter almonds due to Hydrocyanic acid which latter only becomes prominent after the *Chlorine* has volatilised.

The quantities of the chemical substances present in the secretion being very small, microchemical tests were applied in the experiments. For this work, fresh gland extracts were prepared by pounding 200 glands with 10 c.c. of distilled water and concentrating on a waterbath (temperature maintained below 40°C). A blank test was applied in each case for comparison.

1. Gland extract treated with Ferrous sulphate and Sodium hydroxide and evaporated on a waterbath. With the addition of a little dilute Hydrochloric acid and a drop of Ferric chloride, a greenish blue colouration was detected under the microscope.

2. Gland extract treated with yellow Ammonium sulphide and evaporated to dryness. Acidified the residue with a little

dilute Hydrochloric acid. The addition of a drop of weak Ferric chloride gave a characteristic scarlet red colour.

These experiments show clearly the presence of Cyanide in the secretion. Volumetric tests were tried by taking various strengths of Potassium cyanide solution and titrating with Copper sulphate solution. Most favourable results were obtained with 1/1800 N/10 Potassium cyanide solution when compared with the gland extract titrated in the same way. The strength of Cyanide in the glands is, therefore, approximately 1/1800 N/10.

3. Secretion obtained from the glands was treated on a slide with a drop of distilled water, a drop of weak solution of Potassium iodide and a drop of ·5 per cent fresh starch solution. Evaporated on waterbath to a paste. Examination under microscope revealed light blue stained starch grains.

4. Two more experiments were conducted on similar lines one without the addition of the gland secretion, the other by taking a few drops of Chlorine-water instead of gland secretion. In the former starch grains remained unstained, but in the latter case the results were greatly marked as the starch grains were stained deep blue.

All these experiments clearly demonstrate the presence of *Chlorine* which owing to minute quantity could not be otherwise detected.

We may, therefore, conclude that *Chlorine* is an important ingredient of the gland secretion. The presence of Chlorine together with Hydrocyanic acid makes the animal unpalatable and the disinfecting properties of the substances help in keeping the surrounding soil where the animal lives free from bacteria and other micro-organisms.

A detailed account of the structure and physiology of these glands will be published shortly.

M. B. LAL.

Department of Zoology,
The University, Lucknow,
August 1933.

The Life-History of *Limnophyton obtusifolium* Miq.

THE embryo sac of the ALISMACEÆ has been a morphological puzzle. A single species *Alisma plantago* has been investigated by no less than five competent workers—Ward (1880), Fischer (1880), Schaffner (1896), Nitzschke (1914), and Dahlgren[1] (1927), and the accounts of all the five authors are different even in essential respects from one another. The last-named author has studied three other genera of the family and finds that the embryo sac development in all the four is of the "Scilla-type" and there are only 6, rarely 5 nuclei in the embryo sac. He holds that the previous accounts on the embryo sac of *Alisma plantago* were incorrect.

In April 1932, I started some work on the life-history of *Limnophyton obtusifolium* and an abstract of the results obtained was published in *Current Science* (Vol. 2, p. 12). In the last number of the same Journal (Vol. 2, p. 53), Mr. S. K. Narasimha Murthi records some observations which are in some respects very different from those obtained by me. With a view to find out the source of the discrepancy, a fresh study was made of some of the stages and the points of difference are dealt with here.

MALE GAMETOPHYTE.—After the differentiation of the four groups of archesporial cells in the anther, the outer cells divide periclinally and cut off a primary parietal layer which gives rise to the endothecium, a middle layer and the tapetum. The middle layer is ephemeral and is soon absorbed. I am unable to think of any explanation of its reported absence in the material studied by Mr. Narasimha Murthi. At the time of tetrad formation the tapetal cells begin to protrude inwards and "wander" inside the loculus. For some time they preserve their identity, but later they meet irregularly and a true periplasmodium *is* formed, which begins to degenerate after the laying down of the exine in the pollen grains. Too much emphasis need not, however, be placed on the terms "true" and "false" periplasmodium, as defined by Tischler, for as Schnarf[2] points out these are all gradations between the two.

Since my previous note appeared, I have been able to find out pollen grains with male *cells* as described by Mr. Narasimha Murthi, but their presence is not a constant feature. As figured by me in my last note, there are many pollen grains in which there is not the slightest trace of a

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[1] Dahlgren, K. V. O., "Die Embryologie Einiger Alismatazeen," *Svensk Bot. Tidskrift.*, **22**, 1–17, 1928. (The other four works are quoted in this paper.)

[2] Schnarf, K., *Embryologie der Angiospermen*, Berlin, 1927, p. 34.

difference between the general cytoplasm of the grains and that surrounding the male nuclei.

FEMALE GAMETOPHYTE.—Apparently my account entirely agrees with that of Mr. Narasimha Murthi upto the four-nucleate stage. He writes that all four of these divide and the normal 8 nuclei are formed, while I have hitherto maintained that there are only 6. In order to explain the difference Mr. Narasimha Murthi suggests that this may be due to my having examined only later stages when two of the nuclei at the antipodal end had already degenerated.

To meet this objection I am giving here the results of a statistical study made from a recent examination of 100 embryo sacs, in 90 of which egg-apparatus had not yet fully organized, though the synergids had begun to be differentiated. There were three conditions:—

1. The two chalazal nuclei do not divide at all, embryo sacs six-nucleate. This was found in **80** cases.

2. Only one of the chalazal nuclei divides, embryo sacs seven-nucleate. This was found in **15** cases.

3. Both of the chalazal nuclei divide, embryo sacs eight-nucleate This was found in **5** cases.

The results speak for themselves.

I feel convinced that there is a considerable variation in the embryo sacs of this plant and this may also explain, at least to a large extent, the different observations made by Schaffner, Nitzschke and Dahlgren on the embryo sac of *Alisma plantago*. The prevailing condition, however, is the six-nucleate one, as brought out in my last paper, and as found by Dahlgren in *Alisma plantago*, *Elisma natans*, *Echinodorus ranunculoides* and *Damasonium alisma*.

EMBRYO.—Mr. Narasimha Murthi finds that a longitudinal wall is laid down in the terminal cell after the proembryo is five-celled, but I find that this may occur even at the four-celled stage and occasionally it may be delayed to the six-celled stage. The other observations on the embryogeny are in agreement with those made by me.

I am indebted to Dr. P. Maheshwari for his kind help and suggestions. Some slides illustrating the life-history of the plant were also sent to Dr. K. V. O. Dahlgren of Uppsala who entirely confirmed the observations made by me regarding the six-nucleate nature of the embryo sac.

BRIJ MOHAN JOHRI.

Department of Botany,
Agra College, Agra,
August 28, 1933.

Somatic Chromosomes and Microsporogenesis in Cobra or Snake Lily, *Arisœma murrayi* (*Araceæ*).

VERY young plants of Cobra Lily begin to appear in large numbers in Mahabaleshwar, Western Ghats, Bombay Presidency, from about the beginning of the fourth week of May. Cytological observations show that in order to obtain for study all the stages in microsporogenesis it is necessary to fix very young stages of spadix from the plants which are almost underground, or which are still enclosed and whose tops only have just appeared above the subsoil.

The chromosomes are fairly large and the diploid number as seen in root tips is 28. Equatorial plates of the somatic chromosomes at the metaphase are more commonly found in the peripheral region of the root tip. But the most interesting feature is the behaviour of the nucleus in the course of pollen formation. In almost diagrammatic clearness and in an unmistakeable sequence are presented all the various stages through which the nucleus of the pollen-mother-cell passes in its growth and development. And this may well serve as a good example in demonstrating a straightforward microsporogenesis to students of advanced classes. Regarding synizesis one finds it difficult to believe that it is merely an artefact when it presents the same aspect, a closely tangled mass of deeply stained chromatin threads engulfing the nucleolus and lying on one side of the nucleus adjacent to the nuclear membrane, under a variety of fixatives. For a considerable period of time during diakinesis bivalent chromosomes stand well apart from one another in a seemingly clear space bounded by a remarkable clear nuclear membrane, which persist long after the bivalents have undergone considerable condensation and shortening.

Fourteen bivalents in the equatorial plate form the haploid number of chromosomes in the heterotypic division. These have been counted in a large number of heterotypic metaphases and anaphases, and in an equally large number of the same phases

in homeotypic division. As the daughter nuclei are reconstructed distinct membranes or partitions appear in the equatorial regions of the spindles. And in this connection it may be remarked that during the quadripartite division of the parent cell leading to the formation of the pollen furrowing in the cell wall of the pollen-mother-cell is not in evidence.

A detailed account of the behaviour of the nucleus and its divisions studied will be presented in the near future.

J. J. ASANA.

Ismail College,
Andheri, Bombay, S. D.,
August, 1933.

Aligarh New Science College.

By Muhammad Zakiuddin, M.Sc. (Alig.),
Research Scholar, Aligarh.

THE long-expected Science College of Aligarh is now completed due to the painstaking efforts of Nawab Masood Jung Dr. S. R. Masood, the Vice-Chancellor of the Aligarh University.

The erection of the new laboratories in Aligarh has created a new era not only in the History of Aligarh, but the whole of India. Up-to-date Laboratories fitted with modern appliances for Research and Advanced Studies and teaching and practical work, have been installed in separate blocks containing enough accommodation. Each of these blocks are fitted with D.C. and A.C. supply, coal-gas, etc., and arrangements for ventilation and light have been properly made. To each of these Departments is attached a Library containing all the important Journals and Books of Science in English and other European languages.

DEPARTMENT OF PHYSICS.

The Department of Physics extending over two buildings—one for the Research and Advanced Studies and the other for practical and teaching work—containing about seventy rooms,—is under Prof. Dr. R. Samuel, Ph.D. (Gottingen), Nizam Professor of Physics in the University. Dr. H. Lessheim, Ph.D., a well-known Mathematical Physicist of Germany, has been appointed recently to teach Mathematical Physics and Applied Mathematics. Dr. R. K. Asundi, B.A., M.Sc., Ph.D. (Lond.), the discoverer of the well-known "Asundi Bands," is the Reader in Physics.

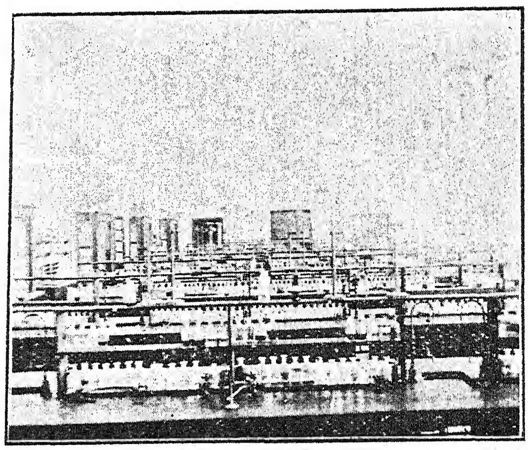
At present there are about 18 research workers in the department working on various problems of Spectroscopy. The Laboratory has been equipped with apparatus for the study of all the regions of Spectra from the Infra-red to the Extreme Ultra-violet and Soft X-Rays. The problems undertaken vary from the study of the Absorption Spectra of liquids, solutions, and vapours in the whole of the Spectroscopic Region, Electronic Impact, Electronic Diffraction, Photochemical Reaction and Band spectra. Apparatus like Zeiss Photometer, Zeiss Abbe Comparator, Two Vacuum Spectrographs, Soft X-Ray Spectrograph, Leiss E_1 Quartz Spectrograph, Zeiss Three Prisms Glass Spectrograph, 10 and 21 feet Grating and Infra-red Spectrograph and other apparatus have been installed.

DEPARTMENT OF CHEMISTRY.

Prof. R. F. Hunter, A.R.C.S., D.I.C., A.I.C., M.Sc., Ph.D., D.Sc. (Lond.), Nizam Professor of Chemistry in the University, is the Director of the Chemical Laboratories. He is assisted by Dr. R. D. Desai, B.A., D.I.C., M.Sc., A.I.I.Sc., D.Sc. (Lond.), and Lt. M. Haider Khan, B.Sc. (Alig.), B.Sc. (Lond.), M.A. (Cantab.).

Prof. Hunter and his students are working on various problems ranging from the study of Tautomerism, Electronic Mobility, Analysis of Organic compounds, to finding out Dipole moment and Absorption spectra of these compounds.

There are about ten research workers, working under Prof. Hunter.



DEPARTMENT OF CHEMISTRY.

The Botanical Laboratories are under Dr. R. A. Khan, M.Sc., Ph.D. (Cantab.), who has recently returned from Cambridge. He is assisted by Dr. A. A. Hyder, B.A., Ph.D. (Gottingen).

The Department has been equipped with all the apparatus required for the study of the Physiological aspects of Botany.

A Botanical garden is attached to the department for growing all the necessary plants and herbs required. At present only three men are working in the department, but it is expected that very soon the number will increase. Special care has been taken to equip the Botanical Museum with the necessary specimens.

DEPARTMENT OF ZOOLOGY.

The Zoological Laboratories are under Dr. M. B. Mirza, D.Phil.Nat., who is assisted by Dr. M. A. Sharif, M.A., D.Sc.

The Zoological Museum has been equipped with all the necessary specimens required for teaching and demonstration. At present there are four research students working in the department on various problems of Entomology and Advanced Zoology.

Recently the Department of Zoology sent a party to the various parts of India to gather fossils and other specimens and the members of the party returned with success bringing a large number of rare specimens.

The plans for the Medical College, College of Technology, Agricultural College, Electrotechnical Department and Engineering College have been completed, and it is hoped that within a few years the big University Extension schemes will be complete.

Aligarh in the past sixty years has been well known as one of the greatest educational centres not only in India, but the whole of Asia, where students have flocked from different parts without the *distinction of colour, caste or creed*, and have imbibed from the fountain of learning so wisely created by the late Sir Syed Ahmed Khan, to whom India is so highly indebted.

Crystals of the Living Body.*

IN the living body, there is a preferential distribution of the various kinds of atoms as for example phosphorus and calcium in bones and teeth, and sulphur and nitrogen in hair. Besides this differentiation, there is a greater one of the molecules into which the atoms are grouped, thus, the several kinds of proteins function differently as constituents of the many organs of the body. A further requisite is order in the arrangement of the molecules. To cite an instance, in hair, the long narrow arrangements of molecules fastened somewhat loosely like bundles, endows it with the property of directive action. This direction is nearly the same as that of the axis of the hair so that it grows in a particular direction and is flexible and strong. If the molecules were distributed in all directions, there is no reason why hair should possess these properties. All processes in the living body follow the laws of physics and chemistry and consequently, function which is connected with orientation means method in molecular arrangements. No artificial arrangements of atoms and molecules has ever been endowed with life nor can an indiscriminate one extend and grow in one direction more than in another. All the parts of the body such as nerves, muscles and tendons possess arrangements which are fitted for their purpose not only by shapes but also by the internal arrangement of their molecules. Hence it is very essential to understand the arrangement of molecules in the living body if we are to understand their functions properly.

Chemical analysis tells us very little of this arrangement. We are only aware of the bricks of the house with very little knowledge of the exact plan of the home of which they form parts. The arrangements of atoms in molecules have come in for wide study by the organic chemists but the relative arrangement of the materials with reference to one another is also of great import. Especially is this so of solids where directive properties come into play. In this study, the X-ray has proved an extremely useful weapon.

The study of solid crystals suggests itself readily because the crystalline form is the result of the molecular arrangement. Thus the properties of crystals of zinc blende on heating and those of resorcinol when suspended in liquid air are exactly those that can be expected in a molecule of the type studied and the X-ray pattern reveals the same characteristics but whatever is true of the whole is true of the unit imbedded in it. It does not mean that the individual unit will behave in this way if taken out of its environment.

This is an important point. The study of a crystal furnishes information regarding a small group of molecules say one, two, three or four. If we determine the arrangement of molecules in this group and of the atoms in the molecule, we can correlate properties and arrangements and thus contribute to one of the greatest problems of physics, namely, the relation between the properties of a substance and the atoms of which it is built. Conversely, using the knowledge, we can apply it to other units by the examination of crystals of which these units form parts. So the position of the various atoms in the molecule determines the characteristics of the molecule; the position of the molecules in a solid determines its crystalline form. In a living body there must be arrangements of molecules of various kinds to various extents. X-ray patterns help us to understand these arrangements.

X-ray studies have generally confirmed the conclusions of the organic chemists and have also further extended their knowledge to greater completion. Thus two amino acids like glycine and alanine each possessing a carboxyl and an amino group of opposite character can condense together with the elimination of water. Willstätter supposed that such combinations can take place in regular alternations yielding chains of indefinite length. Now silk on hydrolysis gives both alanine and glycine. If this regular structure is the cause of the X-ray photograph of silk, the numerical details of the photograph should fit into the chemist's conception. From X-ray studies of various crystals we know that the distance along the chain at which the pattern (two carbons and one nitrogen) repeats itself should be 3·6 A°. Although the X-ray pattern gives a very hazy picture of the position, measurement shows a regular repetition of pattern at a distance of 3·5 A° which is a remarkable coincidence with the calculated value. The X-ray photographs also show that the chains are arranged in a row

* "Crystals of the Living Body"—Friday evening discourse delivered by Sir William Bragg, O.M., K.B.E., F.R.S., at the Royal Institute, January 20, *Nature*, **132**, 11 and 50, 1933.

parallel to the direction of the fibre—an arrangement that we ought to expect.

It is well known that the hair stretches and photographs in a manner resembling that of silk though its chemical structure is similar to those of horn and feathers. Astbury explained this phenomenon by supposing that the chain which forms the backbone of all the proteins is similar to silk. In the keratins they are crumpled up somewhat; tension pulls them straight without breaking them and on release, the contractile forces draw them again together. But beyond the breaking point, the molecules slip past one another and so cannot be restored to their original state. These suppositions are practically demonstrated by X-ray photograph which, for example, in wool, shows repetition at intervals a little less than silk, whereas in hair it is 30 per cent. less; and hair recovers completely after 30 per cent. of extension.

The same hypothesis gives an explanation of the resistance of these substances to enzyme attack, for the crumpled chain protects the molecule from breakage. The compactness masks susceptible points and this is helped by the mutual satisfaction of opposite groups. This only illustrates that not only do the molecules of a chain determine its character but the arrangements of the molecules themselves decide the behaviour of the substance. Arrangements of the protein molecules among themselves are essential to their function in the living body.

These are but the beginnings of future interesting revelations that will follow more precise measurements. The X-ray is a new tool and needs wider application in more cases before it can be properly used and its full capacities understood.

A most interesting example is the examination by J. D. Bernal and his colleagues of the crystal structure of the separate amino acids, vitamins and similar bodies. When such bodies can be crystallised, valuable knowledge of the arrangement of atoms and molecules can be studied. Chemical considerations suggest many possible arrangements which X-ray studies narrow down. Thus Bernal showed the former formula for sterol to be incorrect and later search has been successful in proving his point. Bernal's results indicate the possibility of studying the changes as the configuration is altered step by step, and the comparison of the gradually changing quality with corresponding changes in certain dimensions gives important hints about the constitution of the substance. The optical, magnetic and other constants of a crystal show remarkable dependencies in the form and now we are able to determine the contents of the unit of pattern and sometimes go as far as to find the position of atoms and molecules in the unit: the constants can then be connected directly with the contents of the unit. Another method of arriving at the same direction is to work out the arrangement of atoms in simple crystals to completion. The laborious task cannot at present be applied to complicated cases. The effect of relative positions of various groups can be worked out and the knowledge thus obtained applied to other cases.

Several investigations have been recently done along these lines. One of the results obtained is a better understanding of the details of linkages between carbon atoms. We speak of the single bonds and double bonds. There are two linkages, the close diamond linkage and the wider graphite linkage. X-ray studies show differences between the two linkages that is beyond experimental error. The former is found in fatty acid chains and similar compounds where each carbon atom has four neighbours, two carbon and two hydrogens. The latter occurs in naphthalene and anthracene, the basis of which is the benzene ring; in these carbon has three neighbours as in graphite. It may prove to be the case that the former kind of bond is peculiar to aromatic substances and the latter to the aliphatic. The heats of combustion of diamond and graphite are very nearly the same: so that it takes as much energy to break down the four bonds in the diamond as the three in the graphite. In such a comparison the heat spent on breaking the weak bonds between the network layers of graphite is taken to be negligible.

Such accurate measurements as these encourage the hope that there are exact rules as to distances apart of the atoms, and very probably as to their mutual orientation. Knowledge of these rules will greatly facilitate the determination of structure.

Research Notes.

The Physiological Anatomy of *Ulex europæus* L.

In a paper published by T. S. Raghavan in the *Journal of the Annamalai University* (1, No. 2) the results of an investigation into the anatomy of the vegetative organs and its probable bearing on xeromorphy are set forth. A parenchyma sheath in close contact with the vascular region is identified as a modification of Haberlandt's second system of construction of photosynthetic cells. How far this plant could be regarded as xerophilous is discussed. Increased assimilative surface by ridges and furrows and consequent high stomatal frequency, a well-developed conducting tissue, and the dissected nature of the leaves which besides being resistant to strong winds, also being a means to reduce the distance between the water conducting veins and the evaporating cells of the mesophyll—all these indicate that ulex cannot be termed xerophilous but only drought resistant.

Observations on the Stomatal Distribution and the Rates of Transpiration in Wilting Leaves.

Stomatal distribution and the rates of water lost by wilting leaves of a dozen plants comprising mesophytes, halophytes, and succulent xerophyte have been investigated by T. S. Raghavan (*J. A. U.*, 2, No. 1). Stomatal frequency as well as rates of transpiration in the halophytes are high and therefore they cannot be termed xerophilous. How far the loss of water in wilting leaves is a purely physical phenomenon is discussed. No direct relationship exists between the rate of transpiration and the number of stomata per unit area. Till about three hours after severance from the plant, the leaves exhibit fluctuations in the rates of water loss. The water content of the leaf cells seems to control the rate of transpiration. It is believed that wilting leaves behave like ordinary leaves till a certain time in respect of transpiration. On the water deficit reaching the maximum, the time taken for which varies with different plants, there is only a uniform decline in the rate and no more rises and falls occur.

Development of *Ophiocoma nigra*.

In this paper (*Q. J. M. Sc.*, **76**, part I) Dr. N. Narasimha Murti gives a complete account of the development and metamorphosis of an Ophiuroid. That a 'right hydrocœle' arises as a thickening of the right anterior cœlom in most larvæ in addition to the usual left hydrocœle and that it degenerates as metamorphosis progresses are two points of interest. The author also observes that a 'pericardial vesicle' originates from the right anterior cœlom in the same manner as in the sea-urchin and the star-fish and that it persists in the adult as a thin walled pulsating sac. Another observation to note is that the most posterior lobe of the left hydrocœle does not move across the œsophagus towards the larval right but bends to the right to meet the most anterior lobe which travels towards it after passing round the œsophagus. The author has further shown that all the 'perihæmal spaces' arise as pocket-shaped evaginations from some part of the left posterior cœlom or other, recalling the similar state of affairs in the star-fish Asterias. Yet another remarkable feature of the late larval forms of Ophiocoma is that the outer ends of the cylindrical cells of the stomach are vacuolated and stain deep black in specimens preserved in osmic acid followed by Muller's fluid — owing probably to the presence of fat in them. The fact that in the just metamorphosed larvæ the stomach appears, at first, as a solid mass and later sends out five projections alternating with the arms seems to be a new observation. The work, in short, attempts to verify the results of previous authors and to add new observations wherever possible.

On the Occurrence of Hepato-Pancreatic Glands in the Indian Earthworms of the genus *Eutyphœus* Mich.

In this important paper, [K. N. Bahl and M. B. Lal, *Q. J. M. S.*, **76**, pp. 107—127, pls. ix and x, June, 1933.] Prof. K. N. Bahl of the University of Lucknow has described the structure, development and blood-supply of the "intestinal glands" which occur as paired structures on the dorsal surface of the gut of earthworms of the genus *Eutyphœus* in segments 79 to 83. As the glands in each segment are fused in

the middle line and those of successive segments are connected, it has been rightly stated that it would be just as correct to speak of a single large gland extending over *five* segments. The glands are richly supplied with blood-capillaries and open into the intestine through ciliated apertures? In the physiological part of the work, in which Dr. Bahl, as is indicated in the introductory chapter, was assisted by his demonstrator Mr. M. B. Lal, interesting experimental evidence is adduced in regard to the nature and function of these glands. That the glands do not secrete calcium but a proteolytic ferment is amply proved by digestion-experiments; that their blood-supply resembles a hepatic portal system is brought out convincingly in the illustrations of both sections and dissections; that glycogen-granules are present in the cells has been demonstrated by staining sections with Best's carmine; and, finally, that they develop as mid-dorsal outgrowths of the endodermal lining of the gut has been worked out in embryos. In view of all these characteristic attributes, the glands are presumed by the authors to be hepato-pancreatic in nature and this view is fully confirmed by the situation of the glands—they lie just at the place where the main work of digestion and absorption takes place. The paper is beautifully illustrated and marks a great advance on our knowledge of the morphology and physiology of the oligochæta.

B. P.

Fire Hazards in the Use of Oxidising Agents as Herbicides.

IT is not often realised that certain chemicals, particularly chlorates and dichromates, are not safe to use as herbicides, particularly under conditions where the relative humidity of the atmosphere is likely to fall below 30 or 40 per cent. In his recent publication of the subject (*Canadian Journal of Research*, **8**, 509, 1933) Cook has drawn attention to the nature of hazards attendant on the use of various herbicides both by themselves and in association with other chemicals. The chlorates are generally hazardous by themselves but when mixed with chlorides, particularly those of magnesium or calcium, in equal proportions, they are generally very safe to handle at all the usual concentrations. The most effective mixture would be that containing two-thirds of sodium chlorate and one-third of magnesium chloride. It has a herbicidal power equivalent to about half that of pure sodium chlorate.

It is hoped that the above observations would be of interest to those engaged on the eradication of noxious weeds, particularly in the midst of other forms of vegetation, as in forests or in the neighbourhood of human habitations.

Stabilisation of Chlorinated Hydrocarbons.

ALTHOUGH chlorinated hydrocarbons have lately found much favour as solvents for a variety of substances, yet their instability, as also their tendency to attack metallic containers, have always been a source of trouble to their users. The Imperial Chemical Industries have recently developed a process for the stabilisation of such compounds (*Ind. Pat.*, No. 19646, 1933) which involves the addition of alkylamines the boiling points of which are not substantially different from those of the chlorinated hydrocarbons concerned. The stabilising action of the alkylamines is further augmented by the addition of small amounts of alkalies or alkaline reacting compounds, which, under the working conditions, are capable of liberating the alkylamine from its hydrochloride and which are inert to the chlorinated hydrocarbon. This invention should render chlorinated hydrocarbons still more popular than before.

An Improved Process for preparing Vegetable Fibre Rubber Product.

TWO French Engineers have developed a process (*Indian Paten*, No. 19498, 1932) for the combination of mercerisation with impregnation with rubber. When treated with the mercerising agent the vegetable fibre swells up. It is then washed free from caustic alkali and then pressed with finely dispersed rubber, which may be natural or synthetic, vulcanised or otherwise. The product thus obtained is a compact and homogeneous mass of vegetable fibre and rubber which is useful for a variety of purposes, particularly for making felted materials and in the pneumatic tyre industry. It is not unlikely that these and related products will soon play an important part in the development of a number of products which combine the good qualities of both cellulose and rubber.

Embryonic History of the Germ Cells in *Passer domesticus* (L).

IN this important contribution Hubert W. Blocker (*Acta Zoologica*, Bd. XIV, 1933, five plates and 32 figs.) has given an account of the breeding habits of the bird and confirmed the results of Etyold and Loisel concerning the seasonal variation in the testes of sparrows. In his critical study the investigator has not only given the characteristics of germ cells but also reviewed morphological and experimental studies on the early history of germ cells. The author summarises and concludes his elaborate study of the very vexed question of the origin of germ cells as follows: The primordial germ cells of *Passer domesticus* are of extra-embryonic origin and are first seen in an embryo of one or two somites in a crescent-shaped area at the outer margin of the proamnion. They are found in the ectoderm and in spaces between the ectoderm and endoderm. They remain in this position up to seven or eight somite stage during which time they take on more definite germ cell characteristics. After the arrival of the mesoderm, the germ cells enter the vessels of the vascular area, in part passively during the formation of the blood islands and in part actively by forcing through the endothelial lining of these vessels. In a ten-somite embryo all stages in the process of migration can be observed. The germ cells are carried through the circulation with the blood cells and at about twenty-five somite stage make their appearance in the small vessels of the splanchnopleure where they leave their vessels and begin their migration toward the site of the future gonad, where some of the germ cells take their place among the cells of the so-called germinal epithelium. The lodging of the germ cells in the vessels of the splanchnopleure is attributed solely to mechanical factors, and is dependent on the size and shape of the vessels in this region. The progress of migration of the germ cells from the vessels of the splanchnopleure continues to about thirty-six somite stage, when practically all the germ cells have left the blood vessels. A small number of germ cells become lodged in small vessels of distant regions and never reach the gonads.

There is a shifting of the germinal epithelium with its contained germ cells from the splanchnopleure through the coelomic angle to the somatopleure during the stages from three to four days incubation. During the formation of the gonads and during sex differentiation germ cells are found in all parts of the gonad. The first mitoses of germ cells were observed in a four and one half day embryo. During sex differentiation there is no distinct formation of tubules as has been described for the chick. The first reliable criterion of sex distinction is the relative size of the right and left gonad in the female. A rudiment of the right gonad of the female with the germ cells persists at all stages of incubation. It retains its undifferentiated structure throughout this period. Histologically sex cannot be distinguished before the eighth day of incubation when a cortex begins to form beneath the epithelium of the left ovary. The primordial germ cells are not replaced by a second generation of germ cells but they give rise directly to the definitive sex elements. Their number is increased only by mitosis and no germ cells are derived from somatic sources.

A. S. RAU.

Crocuta pilgrimina, N. Rao—A New Fossil Hyæna.

A NEW species of fossil hyæna, derived from sorely denuded surface deposits overlying the Ariyalur Cretaceous beds of Trichinopoly district, named *Crocuta pilgrimina*, N. Rao, has been described by Prof. C. R. Narayan Rao in the *Half-Yearly Journal of the Mysore University*. The new species makes an interesting addition to the known fossil Hyænæ described by Pilgrim from the Upper Tertiaries and post-Tertiary of various parts of India. The precise affinities of the present fossil with the latter are described by the author. The genus *Crocuta* is now totally extinct from South India, though a solitary species *C. crocuta* is still found living in Africa. The exact horizon of the fossil is a little doubtful, varying from Upper Cuddalore sandstone stage to the Pleistocene. It is hoped that some associated ungulate and carnivore remains obtained from the same locality may solve the question of the age of the Ariyalur mammaliferous beds.

D. N. W.

The Endocrine Factors concerned in the Control of the Ovarian Cycle in *Xenopus lævis*.

THE influence of pituitary extracts on the activity of the ovary in mammals has been

extensively studied, but C. W. Bellerby (*Biochem. Journ.*, **27**, No. 3, 1933) has used *Xenopus lævis* as a test animal with great advantage. The employment of this animal for the experiments has obviated the necessity of killing the animal to examine the condition of the ovary, as the extrusion of the eggs marks the activity of the ovary. Even under normal conditions ovulation in *Xenopus* does not take place in the laboratory so that the extrusion of the eggs after injection of the extract is full of significance. A further aid is afforded by the fact that ova extruded after pituitary injection are devoid of the mucilaginous envelope so characteristic of the Amphibian egg shed in the normal manner. It has been found that ovarian activity can be induced in *Xenopus lævis* even outside the breeding season in the laboratory. In all cases both acid and alkaline extract injections of the ox anterior pituitary were made and the effects of these two are identical in producing ovulation. It is seen that while there is no relation between the number of eggs shed and the dosage, the relation between the percentage response and dosage is evident. In fact this relation is more constant in *Xenopus* than in mammals. And on account of the absence of the necessity of killing the animals, the same set of animals may be used successively for a series of experiments. Ovulation usually occurs within 18 hours after injection, rarely over 48 hours.

The Component Fatty Acids and Glycerides of the Milk Fats of Indian Goats and Sheep.

D. R. DHINGRA (*Biochem. Journ.*, **27**, No. 3, 1933) has extended the work of Hilditch and his co-workers on the fatty acids and glycerides of Indian cows and buffaloes. The author gives a comparative account of the properties of the milk fats of goats and sheep and those of cows and buffaloes and comes to certain interesting conclusions. The goats and sheep which formed the source of the milk fats in this investigation came from two different localities in the Punjab separated by a distance of about 300 miles but fed on the same diet in the same winter season. As compared with the cow and buffalo butter fats the Polenske value of the goat and sheep butter fats is higher while the Kirschner values in relation to the Reichert-Meissel values as also the saponification equivalents are low. Another point of special mention is the higher content of capric, caprylic and caproic acids in the goat and sheep butter fats. This seems to be almost exclusively at the expense of oleic acid. There is, on the whole, a similarity between the properties of the goat and sheep fats and the cow and buffalo fats.

On the Nature of the "Yolk Nucleus" of Spiders.

SUKH DYAL AND VISHWA NATH (*Journ. Roy. Micros. Soc.*, Ser, III, **53**, Part 2, 1933) have come to the conclusion that the albuminous yolk at the periphery of the egg in spiders is not traceable to the mitochondria, the golgi elements or the yolk nucleus and is probably *de novo* in origin. The yolk nucleus of *Plexippus paykulli* is of the same type as described by Wittich. The yolk nucleus of *Plexippus* is differentiated into a cortex and a medulla, the mitochondria being prominent in the former and the golgi elements in the latter, while the "substance specifique" secreted by the golgi in the yolk nucleus of *Tegenaria* described by Weiner is absent.

Science News.

The Twenty-first Annual Meeting of the Indian Science Congress will be held in Poona from January 2nd to 7th, 1934. Dr. Meghnad Saha, D.SC., F.R.S., F.A.S.B., Professor of Physics, Allahabad University, Allahabad, will be President. Intending members are requested to send their subscriptions, preferably before the 1st October, to the Treasurer, Asiatic Society of Bengal, 1, Park Street, Calcutta. Papers submitted for reading at the session of the Congress can only be submitted by Permanent and Sessional members or through Permanent members. No papers are admissible for reading at the Session by any one who has not been enrolled as a member by the 1st October. Papers intended to be read at the Session, must be forwarded together with three copies of an abstract so as to reach the President of the Section concerned *not later than 1st October, 1933*. Abstracts should be type-written and *must not exceed 200 words*. They should not include formulæ or diagrams.

The local secretaries will be Prof. D. D. Karve, M.SC. Ph.D., Professor of Chemistry, Fergusson College, Poona 4, and V. V. Sohoni, Esq., B.A., M.SC., Meteorologist, Meteorological Office, Ganeshkhind Road, Poona 5, to whom all enquiries as to accommodation should be addressed.

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World Petroleum Congress.—More than one thousand delegates from all parts of the globe are attending the World Petroleum Congress which opened in London on July 19. More than 250 scientific papers will be read and discussed. Dr. Bergius, who has been chiefly responsible for the hydrogenation method of obtaining oil from coal is the President of the Hydrogenation Section. In the course of his statement on the opening day, the Prime Minister said that the Government will assist producers of oil from coal, and this makes it probable that the process developed by Bergius will be worked in Great Britain on a large scale. Though the relative merits of the Petroleum and coal oil industries will not be discussed in the Open Congress, the delegates will have the opportunities of exchanging views concerning the latest developments.

The Petroleum industry is by no means restricted to the production of fuel and lubricating oils. Papers pertaining to the properties and uses of bitumen as a material for road-making and insulating material for electrical instruments, have been listed for discussion. There is a section for discussing problems on the gumming of engine petrols, which leads to engine seizures and on "knocking". The possibilities of the use of alcohol and other petrol-substitutes will also be discussed at the Congress.

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The firm of M. Hensoldt & Söhne, Optical Works, Wetzlar, have, in collaboration with Professor Dr. Max Wolff, of Eberswalde, put on the market a photomicrographic outfit, which will record even difficult microscopic pictures. One outstanding feature of the apparatus, is its compactness, the whole equipment complete with microscope and illuminating device being capable of easy packing in an attached case. This will be a welcome addition to the pocket microscope which the same firm made years ago, and the microscopist who is on his travels—on holiday, on expeditions, and so on—is thus enabled to take photomicrographs thus providing the first perfect solution to the problem of transport of a complete photomicrographic outfit. The apparatus can also be used in conjunction with any existing full-sized stand microscope. A comprehensive catalogue, in English, covering all the specialities, has recently been published, and this can be had in India from their Sole Distributors, the Scientific Apparatus and Chemical Works, Ltd., Agra (U.P.), who have advertised this very apparatus separately in this Journal.

* * *

The Ninth Session of the Indian Philosophical Congress will be held at Poona in December 1933, under the auspices of the University of Bombay. The provisional dates of the Session are the 18th, 19th and the 20th December 1933 and the place fixed for the meeting is Fergusson College, Poona. Mr. V. N. Chandavarkar, B.A.(Cantab.), Bar-at-Law, Vice-Chancellor of the Bombay University, is the Chairman of the Reception Committee and Professors, S. G. Sathe, M.A., I.E.S. (Retd.) and N. G. Damle, M.A., Fergusson College, Poona, are the Secretaries. Professor K. C. Bhattacharya, M.A., of the Calcutta University, has been nominated the President of the Session, and H. H. Sir Chintamanrao Appasaheb Patwardhan, K.C.I.E., Raja of Sangli, has kindly consented to open the Session.

The Session will be divided into four sections, devoted to the discussion of papers on (1) Logic and Metaphysics, (2) Ethics and Religion, (3) Psychology, and (4) Indian Philosophy. Members intending to contribute papers must send them so as to reach the Secretaries or Prof. S. Suryanarayana Sastri, University of Madras, Madras, *not later than the 30th September*. All communications for the Reception Committee may be addressed to Professor N. G. Damle, M.A., Fergusson College, Poona, No. 4.

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The Director of the International Organization of Chemical Documentation has sent us a summary of the Programme, the Office International De Chimie, Paris, propose to carry out. The object of this organization which began its labours in 1932, is to study questions of general interest relating to the International Organization of Chemical Documentation. The work of the Conference of Experts which was summoned, led to the adoption of a certain number of recommendations fixing the three principal tasks of the office: (1) To render accessible to all interested persons, the already existing documentation, accumulated in the various centres, depots and collections; (2) to guide the Chemical Documentation which is in course of production, in such a way as to facilitate its registering, filing and diffusion by methods found to be the best; and (3) to ensure co-ordination between the documentation relative to chemistry and that concerning other scientific knowledge in the field of international documentation.

Thanks to these varied operations. The users of such documentation will find that all over the world a practical and rational organization on documentation in chemistry is being carried on

systematically and progressively, liable to be more and more effectively adapted to their needs.

* * *

Under the auspices of the South Indian Science Association, Bangalore, Dr. A. Nagaraja Rao, D.Sc., delivered an interesting lecture on "Applications of Colloid Chemistry in Industry" on Friday, the 25th August. Dr. B. Sanjiva Rao, M.A., Ph.D., presided on the occasion. In the course of the discourse, the lecturer discussed the application of the principles of Colloid Chemistry in the manufacture of rubber and tanning of leather. The application of the observed influence of small quantities of capillary-active materials on the penetration of tannins, dyes, etc., into various animal and vegetable membranes, in the tanning industry, dyeing of textile fabrics, and manufacture of effective pharmaceutical products, was discussed in detail.

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Under the auspices of the Society of Biological Chemists, India, Mr. V. Ramanathan, Cotton Specialist to the Government of Madras, delivered an interesting lecture on Friday, the 1st September, on the "After Effects of Cholam on Cotton". The problem is being pursued by the specialist under the patronage of the Indian Central Cotton Committee, and is of great practical interest in as much as the existing practice of growing cotton after cholam which the ryot cultivates for fodder results in a loss of nearly 15 per cent. of the cotton crop. The effect is not observed if cotton is grown after a crop of Cumbu. A detailed study of the mechanical and chemical characteristics of the soil has been conducted, and the adverse effects of cholam appears to be traceable to the hardening of the soil which makes deep sowing prior to the sowing of cotton very difficult, if not totally impossible. The lecturer also drew attention to various other observations made, such as the effect of harvesting of the cholam before "seed-setting" on the yield of the following cotton crop, effect of growing other fodders instead of cholam, etc. A practical solution of the problem which is economical and within the practical reach of the ryot is being sought. A good discussion followed.

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The Chothe Kukis of Manipur:—Mr. J. K. Bose, Research Fellow, American Museum of Natural History, reports a few interesting observations he made on Chothe Kukis of Manipur, a tribe linguistically classed as old Kukis, whose total strength is not more than 264 heads. They are found only in two villages in two distinct areas. One village is only eighteen miles away from Imphal near Bishnupore by the side of the Cachar road and the other village is just on the Burma border near Tamu. Living in far off villages these people sever all connections with each other. Even in the language of these two people a difference can easily be noticed. The Chothes of Bishnupore are much influenced by their highly cultured neighbours—the Manipuris. In this village they have learnt from the Manipuris the method of plough cultivation and adopted the various implements for it, practically leaving their age-old practice of jhumming.

There are various tales about the traditional origin of this people but among these the tale of an inquisitive monkey who removed a stone from a hole and the ancestors of this tribe came out of this hole and peopled the world is quite interesting.

The Chothes are of moderate stature, with good physique, flat nose and round countenance. The characteristic mongolic fold, high cheekbone and yellowish colour are also very common among them. The girls are healthy and of short stature. They shingle their hair in the Manipuri pattern till their marriage. The deep depression at the root of the nose is remarkable among them.

The relationship system is classificatory and only twenty-four words are used to address different relatives. The term 'apu' is used to address 'mother's brother,' 'father's sister's husband', 'wife's father' and 'father's father'. The term 'api' is used to address 'mother's brother's wife', 'wife's mother' and 'father's mother' and the term 'ani' is used for 'father's sister' and 'husband's mother'. From the use of these above terms a type of cross-cousin marriage with the mother's brother's daughter may be suggested and this is verified from the version of the people who prohibit all other types of cross-cousin marriage except the one mentioned.

Though Col. Shakespeare in his "Lushai Kuki Clans" has noticed five clans among them, we found that the Chothes are divided into six eponymous clans with an interesting type of marriage regulation on the basis of tri-clan system. The clans are Thao, Hiyang, Marim, Piring, Jurung, Mekhong or Marim-mekhong. These divisions are exogamous and they regulate marriage amongst the people. The preferential mate for a man is his mother's brother's daughter and for a woman is her father's sister's son; but now-a-days the rigid rules of marriage are slackened and even in some cases they are allowed to marry girls from other tribes. In one of the genealogies we find that 'Luithang' a Chothe Kuki first married a Chothe girl and then after some years wanted to marry again but no girl was available for him within the village. He then, with the permission of the village officers, married a girl of Wainem tribe from Tipperah. This girl was then adopted as the clan-sister of his former wife and she was not debarred from joining in any of the social or religious festivities of the tribe.

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Mr. Jatindra Mohan Datta, writing on the subject of Polyandry, draws attention to a type of "Qualified or Limited Polyandry" existing in the district of Rajshahi in northern Bengal. This is found among the *Bausphors*, a low Musulman caste, who pledge their wives to other men. Any children born while they are so pledged are divided equally between the pledger and the pledgee. During the continuance of the pledge, the pledger-husband has occasional access to the wife, especially at the time of periodical payments of interest and at ceremonial occasions in the family of the pledger-husband. On full repayment of the debt the wife is redeemed. However, on the death of the pledgee, the woman observes mourning similar to that observed on the death of her own husband, but only for a shorter period and in a less intense form. If, before the debt is repaid, the pledgee dies, his family retains the woman until the balance is paid, but no one has any right of access to her.

As Polyandry in any form is not recognised under either the Hindu or the Muhammadan systems of Law and as adultery is punishable with imprisonment for 5 years, the practice is dying out.

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An ordinary meeting of the Association of Economic Biologists, Coimbatore, was held on July 20 when two papers entitled (1) "Some introduced weeds of South India" by C. Tadulingam and G. V. Narayanaswamy and (2) "A Haploid Plant in Rice" by K. Ramiah, N. Parthasarathi and S. Ramanujam, were read and discussed.

Dr. C. D. Darlington, D.Sc., Ph.D., Cytologist, John Innes Horticultural Institution, London, who was on a short visit, visited all the plant breeding sections at Coimbatore. He was entertained at tea by the Association of Economic Biologists, on the 13th August and before leaving for Colombo, the same evening, delivered an interesting lecture on "Chromosomes and Plant Breeding" to the members of the Association.

* * *

An ordinary monthly meeting of the Asiatic Society of Bengal was held on Monday, the 7th August, at 5-30 P.M., when two papers, one by Mr. Harit Krishna Deb on "A Newly discovered Asokan Pronouncement" and another by Mr. Himansu Bhushan Sarkar on "Date of Introduction of the Saka Year in Java", were read. An exhibit from Mr. Baini Prasad—"A Habitat Group of Indian Storks" was shown and a few remarks on its preparation made. Specimens of "the Snail, *Rachisellus punctatus* (Anton), in summer sleep," were exhibited by Dr. S. L. Hora, and were commented upon.

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In view of some enquiries regarding Life Subscription for *Current Science* it is hereby notified for the information of all those interested that the Life Subscription is Rupees *One Hundred Only* (Rs. 100).

* * *

The news of the appointment of Prof. Hans Pringsheim of Berlin, as Professor of Technology in the Andhra University has reached us, as we are going to the Press. Prof. Pringsheim is a specialist in sugar, starch, cellulose and fermentation with wide industrial experience, and his appointment will be received with great jubilation all over India. We welcome him to India and congratulate the authorities of the Andhra University for obtaining the services of so eminent an Industrial Biochemist.

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We acknowledge with thanks the receipt of the following :—

"Nature," Vol. 132, Nos. 3324 to 3327.

"The Chemical Age," Vol. 29, Nos. 733 to 736.

"The Scientific Indian," Vol. 10, No. 55.

"University of Cambridge School of Agriculture Memoirs," No. 5.

"Canadian Journal of Research," Vol. 8, No. 6.

"The Journal of Chemical Physics," Vol. 1, No. 7.

"The Indian Forester," Vol. 59, No. 8.

"The Biochemical Journal," Vol. 27, No. 3.

"Experiment Station Record", Vol. 67, Index Number.

"The Review of Scientific Instruments," Vol. 4, No. 7.

"Proceedings of the Conference of Medical Inspectors of Schools, Madras," 5th and 6th August 1932.

"Proceedings of the Academy of Natural Sciences of Philadelphia."

"The Journal of Nutrition," Vol. 6, No. 4.

"Bureau of Education, India," Pamphlet No. 30, 1932.

"Berichte Der Deutschen Chemischen Gesellschaft," 66 Jahrg. No. 8.

"Journal de chemie Physique," Tome 30, No. 6.

"American Journal of Botany," Vol. 20, No. 7.

A great impetus to Industrial Development in Central Provinces has been given by the passing of the State aid to Industries Bill. It is a matter of common knowledge that the condition of many of the important organised industries in the Province such, for example, as the textile industry, oil industry, glass industry, cement and soap industry, have been considerably affected either through foreign competition or necessity to import main raw materials from outside, which brings the cost of production to a high figure. The manganese industry is in a deplorable condition and many of the shellac factories have been closed down. The cottage industries, as in other parts of the country, suffer mainly through the lack of organisation to sell the products, or seek information regarding the needs of the urban buyer. The Department of Industries is no doubt helping the indigenous industry by organising exhibitions and conducting propaganda. The Bill which has been recently passed in the Council seeks to give aid to deserving industries by (1) granting loans, (2) guarantee of cash credit, overdraft or fixed advance, with a bank, (3) guarantee of a minimum return on the whole or part of the capital of a joint stock company for a fixed period, (4) the grant, under favourable terms, of land, raw materials, etc., (5) the grant, free of charge or under favourable circumstances, of the service of experts or Government officials for starting or advising on an industry, and (6) payment of subsidies for the conduct of research or the purchase of machinery.

Reviews.

ELEMENTS OF OPTICS. By Dr. J. Valasek. (McGraw-Hill Book Company, 1932. Pp. xv+ 254. Price 13*s*. 6*d*. net.)

The book under review is intended to supply the need of the junior students in college classes for an elementary text-book on optics. With the rapid advances of science in general and physics in particular, has increased the demand for text-books which present the full scope of the subject striking a proper balance between the old and the new. This is especially difficult in optics—" the centre of activity in physical research "—where the recent discoveries have so revolutionised its scope that no book on the subject would give the proper perspective if it did not deal with the modern developments which have bridged the gulf between the corpuscular and the wave theories.

The first nine chapters of the book are entirely devoted to a clear exposition of Geometrical Optics and include also such interesting topics as colour photography and television. The reader is first introduced to the wave aspect of light in chapter IV and this has led to a dual treatment of Reflection and Refraction in the succeeding chapters. Chapters X to XII deal exclusively with the consequences of the wave nature of light. Chapter XIII on Radiation is a fairly comprehensive, though elementary, treatment of the problem in all its aspects. Here the student is first introduced to the makers of modern physics who have been responsible for the solution of the riddle of atomic structure. In this up-to-date treatment of the subject, the more recent notation for spectroscopic terms might have been more appropriately adopted. The next chapter gives an elementary exposition of the theory of relativity and leaves the uninitiated student in doubt as to its place and function in an elementary text-book on optics. The concluding chapter is a broad survey of the theories regarding the nature of light and ends in a rather philosophic note, with a mystical touch. Select problems and a comprehensive appendix form a special feature of the book.

The author must be congratulated for successfully presenting a book which blends the classical and the modern ideas in a way useful to the student beginning his college career. The popularity of the book would no doubt be enhanced by a more moderate price. The get-up of the book leaves nothing to be desired. The book is an excellent introduction to Optics and we heartily recommend it to junior students in Universities.

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THE NEW BACK-GROUND OF SCIENCE. By Sir James Jeans. (Cambridge University Press. 7*s*. 6*d*. net. 1933.)

The present century has witnessed such a new orientation of scientific thought as could not have been even dreamt of by an exponent of the mechanistic views of Nature so firmly established in the previous century. What Lord Kelvin saw as two small clouds that were visible as two small specks on the fair horizon of the Physics of the last century have developed into huge storms that have swept away most of the highly cherished and apparently unassailable picture of the universe which two hundred and fifty years of inquiry following Newton had filled in. One of these is the Quantum Theory due to the genius of Max Planck and the other the Relativity Theory which Einstein gave to the world. The luminiferous æther of Faraday and Maxwell was denied its claim to reality and a broad synthesis was effected by uniting space and time into a single entity whose geometrical properties provided an accurate representation of gravitation and of electricity. The Quantum Theory in the hands of Planck, Einstein and Bohr made clear many hitherto obscure facts of fundamental importance, but it was a thing apart whose connection with the older and well-established wave theory was a big puzzle. The brilliant synthesis effected by Heisenberg, De Broglie, Schrödinger and Dirac solved this puzzle, but raised other more fundamental questions that affect Physics as well as Philosophy. The law of causality, the nature of the external world, its objective reality and the doctrine of free will have all lost their original claim to our implicit belief, at least in the form in which they were familiar to us, and a new philosophy directed by Science is in the process of formation. The common sense picture of the world has failed to give a faithful representation of reality as a whole, and a picture in terms of new mathematical symbols and equations is the only representation that has so far stood the test of experiment. While Physics is thus becoming less and less easily intelligible in terms of every-day ideas, the demand on the part of the layman for a knowledge of

its present state is becoming more and more insistent. Einstein's paper on a new unified field theory became a best-seller in spite of its being absolutely unintelligible to the layman. This enormous increase in public interest in Physics has been attributed to the failure of religion to satisfy the modern mind and the desire for a proper substitute. However, the need for clear and, if possible, non-mathematical accounts of modern Physics has been felt even by many physicists themselves. In the ability to satisfy such a demand adequately and with authority no one is better qualified than Sir James Jeans. His presentation is something inimitable and his style most charming. This has now become common knowledge and the popularity of his books is a true testimony to the excellence of his writings. In this new book Sir James has given a most stimulating account of the development and present state of the special and general theories of Relativity as well as of Quantum and Wave Mechanics. We already owe to Sir James himself some illuminating disquisitions on the Relativity Theory, but nothing quite like his presentation of Quantum and Wave Mechanics has so far been available to the average reader. The freshness of the outlook and the keenness of the analysis is matched only by the felicity of simile and illustration from facts of every-day life. Even men of science can but profit from a perusal of the book, since the philosophical implications of the new theories have been detailed by a master hand. In the book "Where is Science Going" of Planck, Einstein is represented as telling Murphy that Jeans is fundamentally quite in agreement with other physicists with regard to the Physics, although he may be at variance in respect of its philosophical meaning. In the present book, however, the agreement is more pronounced than the variance, and the quotations which Sir James has given from Planck's book show that he agrees with other scientists in all essentials, and only differs on occasions in respect of predictions as to the future course of Physics. There seems to be, however, an emphasis on the view that matter may after all turn out to be of the nature of mind. But whether he agrees or not his views are presented with such persuasive logic that it is difficult not to agree with him. We heartily recommend the book not only to the layman interested in Modern Physics but even more so to Physicists who require a tangible and authoritative exposition of the implications of recent Physical theories and speculations.

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REMEMBERING: *A Study in Experimental and Social Psychology.* By F. C. Bartlett, M.A., F.R.S. (Cambridge University Press. Price 16*s.*)

This book forms a worthy contribution to a distinguished series of the Cambridge Psychological Library. It is a study based on experimental observations extended over a period of about twenty years. A theory of *remembering* is developed in this book which gets rid of the notion that memory is primarily a reproductive or repetitive function. "Remembering is not the re-excitement of innumerable fixed, lifeless, fragmentary traces as usually supposed. It is an imaginative reconstruction depending on our attitude towards a whole mass of organised past reactions. What we call memory traces are interest-determined and interest-carried. They live with our interests and change with them." If memory itself is constructive how are we to distinguish it from constructive *imagination?* Mr. Bartlett is not unaware of the above objection. He points out that the chief differentiating marks are to be found in the range of material and the precise manner of their control. Remembering is schematically determined. In imagination, construction develops, as it proceeds. In constructive *thinking*, however, we come back to greater rigidity of control.

Mr. Bartlett's theory of Remembering brings remembering into line with *imaging.* More important still, it gives to *consciousness* an important function, it enables the organism to escape from the sway of immediate circumstance, to respond to stimuli at a distance—a function that cannot be equally well accomplished by any purely physiological process. In the face of the function now definitely assigned to *consciousness* by Bartlett, the Behaviourist account of *consciousness* becomes increasingly untenable.

M. V. GOPALASWAMI.

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ACHARYA RAY COMMEMORATION VOLUME. (Calcutta, 1932.)

Sir Prafulla Chandra Ray holds a unique position among scientific men in India not only because he is the founder of a very flourishing school of Chemistry in Calcutta

but also for his work in inspiring and pioneering several flourishing industries, such as the Bengal Chemical and Pharmaceutical Works, the Bengal Pottery Works, the Calcutta Soap Works, the Bengal Canning and Condiment Works, etc. In addition he has done most valuable work for social reform, in the cause of education and other activities which are fully detailed in the Foreword by the President of the Board of Editors of Acharya Ray's Commemoration Volume which was conceived as one of the tributes to be paid to the savant's septuagenary celebration on the 11th December 1932. The Board of Editors, as is explained in the Foreword, decided to bring out "a handsome volume dealing broadly, among others, with such subjects as science, literature, economics and industries, sociology, religion and philosophy" and invited contributions in Bengali, English, Hindi and Sanskrit. The beautifully got up volume of 615 pages, with two portraits of Sir Prafulla, 17 plates and numerous text-figures, is the result of the untiring efforts of a distinguished Board of Editors and, more particularly, of Dr. Satya Churn Law, the Honorary Secretary. It would probably not be out of place to mention here that but for Dr. Law who volunteered to bear the entire expense in connection with the publication of the volume and devoted a great deal of time and energy to it, the work might not have appeared in its present form.

In the volume there are 74 articles by men of various nationalities from different parts of the world. As is natural in a work of this type, almost one-third of the articles deal with one aspect or another of Sir P. C. Ray's work and a fair number of them are in the nature of appreciations of his multifarious activities. Amongst special contributions of this type one has to mention articles by such distinguished personalities as Dr. H. E. Armstrong, Sir J. C. Bose, Dr. M. O. Forster, Dr. G. J. Fowler, Mr. M. K. Gandhi, Dr. Rabindra Nath Tagore, Mr. Ramananda Chatterjee, and others. All these articles clearly indicate the high regard, affection and respect in which the distinguished scientist is held not only by his countrymen but by workers all over the world.

Amongst general contributions may be classified such articles as deal broadly with scientific, economical, industrial, sociological and philosophical problems. Of roughly 20 such articles, a few may specially be mentioned:— Principal Bhattacharyya on Sanskrit Treatises on Alchemy which have been translated into Tibetan, Dr. De on "The Hindu College and the Reforming Young Bengal," Dr. S. R. Das on "Time in Ancient, Mediæval and Modern Chronology," Mr. L. Gupta on "The Singbhum China Clay Industry," Dr. H. Haldar on "Rammohan Roy's Conception of Universal Religion," Dr. R. C. Majumdar on "The Spirit of Exploration and Adventure in Ancient India," and Dr. M. N. Saha on "Need for a Hydraulic Research Laboratory in Bengal". There are also a number of high-class literary articles of which "Tansen as a Poet" by Dr. S. K. Chatterji and "Bengali Manuscripts at Evora" by Dr. S. N. Sen deserve special mention. Of the contributions on physical science, reference may be made of Dr. T. Morgan's paper on "Experimental Researches on Co-ordination," Dr. Armstrong on "The Future of Chemistry in India," Mr. N. C. Nag on "Micro-Chemical Method for Detection, Separation and Estimation of Nickel and Cobalt," Dr. B. K. Singh on "The Doctrine of Symmetry in Chemistry and its Significance to Molecular Configuration" and Dr. M. K. Srinivasan on "The Preparation of Manganese Dioxide Sol.". The number of biological contributions in the volume is comparatively large—almost one-fifth of the total contributions—and these deal with such abstruse subjects as an account of the Theories of Sex in Fungi, Rôle of Aquatic Vegetation in the Biology of Indian Waters, Pre-Linnæan Writers on Indian Zoology, Structural Adaptations of various animals, Voice of Insects, Identification of birds in Kalidasa's writings, Importance of the study of Embryology, etc.

The work in general constitutes a very valuable production and deserves all commendation. The only drawback that the reviewer finds is that the Board of Editors, probably in trying to publish almost all the contributions received in response to its appeal, has not used its discretion in refusing some of the less suitable articles, while the privilege of using the editorial pen does not seem to have been exercised in most cases.

B. P.

* * *

THE METHODS OF CELLULOSE CHEMISTRY. By Charles Doree. (Chapman and Hall, Ltd., London, 1933. Price 21*s*. nett.)

The above is a highly useful contribution to an important branch of science, the

application of which has progressed ahead of the related analytical methods.

The author, who has had several years of active experience in the line, deals with the subject in a refreshingly intimate manner. The first few chapters are devoted to the preparation of pure cellulose and the methods of investigating transformations that attend its treatment under various conditions. Particular attention is devoted to the physical and physico-chemical methods which have come into considerable prominence in recent years. The following chapters are devoted to the properties and behaviour of oxy- and hydro-celluloses the technical importance of which are now being increasingly realised. The degradation products of cellulose and their bearing on the structure of related carbohydrates are also described in some detail. A useful chapter is devoted to the detection and estimation of the extent of damage to cotton and linen and other cellulosic goods through various agencies.

The second part of the book deals with synthetic derivatives of cellulose which have come to play such a large part in industries in recent years. The methods of investigating the different cellulosic esters are also described in careful detail.

The third section deals with compound celluloses. This portion relates to the fundamental relations between the naturally occurring cellulosic materials and could, perhaps, more appropriately form the opening chapters of the book. Various methods employed for the examination of celluloses and lignins and related products are described in careful detail: The chemistry of lignin and peptic substances are also dealt with at some length. The text is followed by a few tables and a good index.

The book is definitely an advance on most of the other publications on the subject which have appeared in recent years. It is not, however, free from certain defects which characterise many books on analytical chemistry. The author has, presumably, tried many of the methods that he describes but has refrained from commenting on them. This is rather unfortunate because there are numerous methods for the examination of cellulosic materials most of which are either highly defective or have only restricted application. The student of cellulose chemistry would, therefore, have welcomed the personal touch of the author after the description of each method. A few lines indicating the merits and demerits of the different methods with some suggestions for successful handling of the products would have greatly enhanced the usefulness of the book.

The text is presented in a readable style. The matter is printed on good paper and that combined with freedom from type mistakes is highly complimentary to the efforts of the publishers. The price is quite reasonable and considering its usefulness it may be said that the volume deserves to be in the hands of not only those engaged on the analysis of cellulosic materials but also those engaged on researches in the related subjects.

* * *

UN LAC ACIDE DE MONTAGNES ANCIENNO. LE LAC DE LISPACH, DANS LES VOSGES. ETUDE HYDROBIOLOGIQUE. By E. Hubault. (*Ann. Ecol. Eau. For St. rech. exp. for.* Tom IV, fas. 2. 1932.)

In this interesting paper M. Hubault reports the result of his study on the fauna of an acid lake in France. In addition to hydrogen ion concentration, he has studied the oxygen content, temperature, total quantity of electrolytes, phosphate and silicate contents of the water. Regarding fauna he has restricted himself to zooplankton.

The pH at a depth of 5 meters varied from 5·3 to 5·7, which indicates that the water there was fairly acid. Near the surface the pH was 5·8 to 6·5, that is, the water was quite near the neutral point. It would, therefore, have been very interesting if the author had enumerated the fauna of the two strata separately.

The comparison of the fauna of the acid lake with those of other lakes in the neighbourhood shows that the fauna of this lake has several interesting features. The Peridiniem *Ceratium hirundinella* common in other lakes is absent in the acid lake. The Rotifers are represented by very few species. Of the insects and fishes, only *Chironomid larvæ* and *Salmo fario* respectively were obtained.

H. S. P.

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A MANUAL OF PRACTICAL INORGANIC CHEMISTRY. By Dr. E. H. Riesenfeld, Professor at the University of Berlin. Translated by Prof. P. Ray, M.A., University College of Science, Calcutta; being an authorised translation of the latest German edition of Anorganisch-chemisches. (Praktikum. Pp. xxiii + 471. Chuckervertty, Chatterjee

& Co., Ltd., 15, College Square, Calcutta, 1933. Price Indian Rs. 6; Foreign 9*s*.)

This book is intended to serve the needs of beginners in qualitative analysis and inorganic preparations.

In addition to prescribing the conditions under which the tests for radicles are to be applied, this book provides information regarding the sensitiveness and reliability of several important reactions of the ions. The methods of separation of the commoner elements are described in a manner which will enable the student to choose and apply the particular method which is likely to be most suitable to his purpose. The inclusion of some microchemical tests and "spot reactions" makes this book particularly useful.

The sections dealing with inorganic preparations have been judiciously distributed throughout the book and provide valuable hints concerning the manipulative operations involved therein. Sixty-two exercises are set out in detail and these include almost all the typical inorganic compounds.

A most praiseworthy feature of this book is the easy manner in which it introduces the reader to questions of theoretical importance such as complex salts, allotropy and isomerism. This book fulfils all the requirements of a text-book of practical chemistry and can be heartily recommended for general use in college classes.

K. R. K.

* * *

STUDIES IN MASS PHYSIOLOGY: *The Effect of Numbers upon the Oxygen Consumption of Fishes.* By F. Schuett. (*Ecology*, XIV, pp. 106-122. 1933.)

In this important paper the author shows that when four fishes are present in a given volume the amount of oxygen consumed per fish is lower than the amount consumed by an isolated fish in the same volume. This phenomenon of "group effect" has been observed by the author in 4 genera of non-schooling fishes and he suggests that it may be a general rule for all such fishes.

Regarding the reasons for the 'group effect' the author concludes that factors such as low pH, accumulation of CO_2 or reduction of oxygen tension do not appear to be important. He shows that within considerable ranges the oxygen consumption is independent of the oxygen tension of the medium down to near the asphyxial level. According to the author delicate and subtle biotic mechanisms work within the confines of a restricted environment, which produce definite and important changes in the interactions within a community living in the environment. The exact nature of the biotic mechanisms is not known and the author promises to throw some light on the subject after completing some more investigations.

H. S. P.

* * *

SOME PTERIDOSPERMOUS PLANTS FROM THE MESOZOIC ROCKS OF S. AFRICA. An important contribution to our knowledge of the Mesozoic flora is embodied in a recent paper by Dr. H. H. Thomas (*Phil. Trans. Roy. Soc.*, Ser. B, **222**, 1933) dealing with a well preserved collection of plant fossils from the Molteno beds of Natal. The material was collected from the sandstones, grits and dark shales, forming the base of the Stormberg series—the uppermost subdivision of the Karoo system. This area has been thoroughly mapped and described by Dr. A. L. Du Toit and on several decisive evidences, these plant-bearing Molteno beds are regarded as middle Triassic in age.

The material described by Dr. Thomas in his paper consists of about 30 specimens of seed-bearing structures, 25 specimens of pollen-bearing structures and a large number of isolated seeds. After a very detailed and careful examination of all this material, Dr. Thomas has been able to establish a new family *Corystospermaceæ* and define four genera in this family—*Umkomasia*, *Pilophorosperma*, *Spermatocodon* and *Pteruchus*—the first three of which have been based on the study of the female inflorescences and the last one—*Pteruchus*—on the study of the male inflorescences. The seeds are gymnospermous borne in cupules on the ends of branches forming a regular inflorescence. A detailed account of the form, character and cuticle structure of the cupules, as also the cuticle structure of the epidermal cells has been given in each of the genera and several species have been diagnosed—2 species of *Umkomasia*, 8 of *Pilophorosperma*, 1 of *Spermatocodon*, and 8 of *Pteruchus*. The author next passes on to certain morphological considerations which lead to a discussion of such vital problems as our concept of the 'sporophyll' in connection with the origin of the reproductive structure, the ancestry of the Caytoniales and their relation to Pteridosperms, and the relationship between the Pteridosperms and the

flowering plants. On the strength of his present work, Dr. Thomas asserts that the concept of the "seed-bearing leaf" is an illusion and suggests that gymnospermous seeds (like those of *Corystospermaceæ*) must be regarded as terminal structures formed at the ends of branches and not as marginal structures borne on a typical foliar organ. The present study of the *Corystospermaceæ* has also served to provide further grounds in support of the suggestion made by Dr. Thomas himself in 1925 that the Caytoniales as a group may be derived from the palæozoic pteridosperms by the closing of the cupule, and thus confirms the author's belief in the derivation of the modern angiosperms from the same group. On the whole there is no doubt that the paper forms a very valuable contribution "towards the elucidation of the nature of the floras of Mesozoic times and of the affinities and systematic position of the plants composing them." L. R.

METALS (All about Metals). By R. N. Bhagvat, M.A., B.Sc., Professor of Chemistry, St. Xavier's College, Bombay. Pages vi+222. (Published by the author. Price Rs. 3-0-0.)

"The following some two hundred pages are devoted towards giving something of everything of the chemistry of metals in as non-technical a language as could possibly be done without any way harming the scientific side of the subject. Quite a number of tables are given to give at a glance the comparative merits and demerits of different metals when put side by side. These tables are made as eloquent of their purpose as possibly they could be done so and I believe would be found very useful and instructive."

The extent to which the author has succeeded in not in "any way harming the scientific side" can be gathered from the following passages, which are just typical examples of the thousands scattered throughout the book.

P. 27. "When *in bulk* the metals reflect light from polished or freshly cut surfaces, and this is called the *Metallic Lustre.* Most of the metals when very finely powdered are black, except magnesium and aluminium which have shining appearance."

P. 38. "Pure zinc is scarcely affected by acids, because the hydrogen first formed adheres to the metal in a thin, continuous film which prevents the acid from coming into further contact with it. In generating hydrogen in the laboratory it is usual to avoid this difficulty by adding a few drops of a solution of copper sulphate to the glass bottle containing zinc and water before introducing the acid. *This coats the zinc with copper, from which the hydrogen produced, when the acid is added, escapes without difficulty.*"

The book contains many printing mistakes, and the style and grammar could do with some improvement.

P. 12. "It thus happens that chemists have not always agreed as to the arrangement of the elements in this subdivisions" (metals and non-metals) .... "But arsenic has a distinct relationship to antimony which is universally included among the metals (according to some) ...."

P. 13. "In ores the proportions of the chief metals are quite varying in as much as in iron mining, half the weight of the ore has to be iron to make it a good ore, while a copper ore with even less than two per cent of the metal is worth mining."

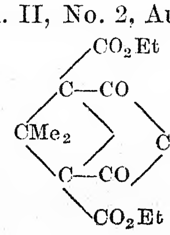
We do not see much merit in this book, excepting that it is neatly got up. The paragraph on p. 9 referring to Charaka's idea of metals is very unæsthetic, and could certainly have been avoided. The book, however, contains a certain amount of useful information, which if presented in a greatly revised form, will be welcomed as a 'general' book both for the student and the layman.

G. R.

Erratum.

Current Science, Vol. II, No. 2, August 1933, page 53, right-hand column, Formula I.

For



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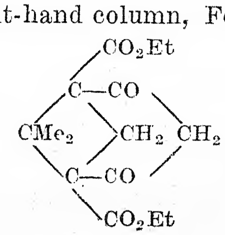

CURRENT SCIENCE

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CONTENTS.

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The Marine Fisheries of India.

A RESOLUTION to start research in pisciculture intended to be moved by Mr. R. V. Jadhav at the last session of the Legislative Assembly was disallowed by the Governor-General on the ground that the subject of fisheries belongs to the transferred half of the Provincial Government. To people who live in countries where a unitary system of Government prevails, the division of administrative functions between the Central and Provincial Governments and the subsection of responsibilities of reserved and transferred halves of provincial governments must be perplexing. It is difficult to discover any scientific basis in the allocation of the Departments of Land Revenue and Forests to the reserved half and those of Education, Medicine, Industries and Fisheries to the Ministers responsible to Provincial Legislature. The Scientific departments, quite as much as the Military and that of Foreign Affairs, have an all-India importance in promoting the moral and material welfare of the people as a whole; division of the interests of the country as administered at present cannot accelerate their progress at the rate and in the direction indicated by national aspirations. Constitutional reforms devised to satisfy the political ambitions of the provinces, frequently fail to secure the advantages of a Central authority directing the uniform progress of the nation-building and wealth-producing departments, and the transfer of Education must tend to lop-sided development and that of Fisheries, to wasteful duplication of effort.

India has an extensive coast line and the sea is full of wealth, capable of providing lucrative employment for millions of people and of adding considerably to national prosperity. We have before us two interesting documents, the Report of the Committee on Fisheries in Madras and the Report of Mr. H. T. Sorley on the Marine Fisheries of the Bombay Presidency and we are convinced that the views expressed by them can only point to the necessity of restoring the post of the Inspector-General of Fisheries formerly held by Dr. Francis Day and of the taking over by the Central Government of the administrative control of the Department. Discussing the problem of scientific research, the Madras Committee come to the conclusion that "it is evident to the Committee that research

is urgently needed in every branch of the department's work before any further appreciable progress can be made" but Mr. Sorley advises the Bombay Government "to leave severely alone matters like research and the development of by-industries of fishing" as one of the lessons to be learnt from the experience of Madras. Mr. Sorley, however, recognises that the gaps in the knowledge of the conditions and habits of life of the Bombay marine fishes must make it difficult to deal with fishery development on its scientific side, but hesitates to recommend even the establishment of a Fishery Department in Bombay on the lines analogous to that of Madras. Since the expenditure of public funds on the provision of a fishery research institution is deprecated by Mr. Sorley because the public is not generally prepared to respond in a practical way, he suggests that research should, however, be the proper function of the University and the Bombay Natural History Society which should, in the first instance, collate and make available for the education of the public the results of such scientific research on Fisheries as has been carried out in India and elsewhere during the last thirty years. The function of the State in fostering the fishery development according to Mr. Sorley is partly by encouraging practical methods of fishery technique and partly by conducting scientific research in the 'narrower sense'. The spirit and scope of such research are discussed in a short paragraph which forms the concluding part of the report.

The development of the fisheries industry is part of the wider problem of the food requirements of the people and in a country like India where the diet of the people is as diversified as their language, no amount of propaganda in favour of "Eat More Fish" will overcome the deep-rooted religious convictions. According to the Hindu conception the primary function of food is to promote a clear understanding and suppress evil passions which retard the progress of the soul and vegetarian diet is believed to assist man in clearing his mind and refining his emotions. This was not, however, the ideal of the Aryan progenitors. Whatever else the reformed diet may or may not have done, it has gradually undermined the physique of the people, deprived them of the spirit of adventure and of martial qualities and paved the way for the Sarada Act. The physical efficiency of the people depends on a well-balanced diet providing the proper nutritive value and standard requirements of the normal individuals of both sexes and all ages in proportion to the work they are engaged in. The value of science to the people is that it gives prescience and the nation that ignores the results of the science of dietetics must be content to remain timid, inefficient and disorganised. We can foresee a time when the food of orthodox India will conform again to Aryan standards and Manu's permissive law, "Yet the two fish, called *Pát-hína* and *Róhita*, may be eaten by the guests when offered at a repast in honour of the Gods or manes; so may the *Rájíva*, the *Sinhathunda* and *Sasalka* of every species." If the daily ration of India is more universally and generously supplemented by the produce of the sea, perhaps the severity of the famines which periodically overtake the people would be mitigated to an appreciable extent.

The policy of the Local Governments has been to make the Fisheries Department pay its own way, but the Agricultural Commission in recommending that a longer view be taken has pointed out that the necessity of improving the daily diet of the rural population implies a prosperous and well-conducted fishery industry which is a source of social and material wealth to the State. The annual value of the output of the fisheries in Japan is £ 30,600,000 and that for the Bombay Presidency is estimated at Rs. 80,30,000 or £ 5,35,333. The low economic position of the industry is vividly portrayed by the fact that only 0·57 per cent. of population is engaged in catching fish and the annual catch per fisherman amounts to 1·55 tons whose total value is Rs. 66–3–8. In the United Kingdom the total annual catch per head of fisherman is nearly four times the output of the Indian and its estimated value is Rs. 1,060–3–0. In recent years there has been a falling off in the fishing population and according to the recent census figures the drop in the Bombay Presidency is slightly over 22·3 per cent. and in Karachi it is a little under 50 per cent. This depletion is all the more significant when we compare the relative proportion of people using fishing as a source of livelihood to that engaged in agricultural and farm occupations; the former is 1·1 per cent. of the latter. Naturally the fishermen must in the long run give up their hazardous and non-remunerative occupation and adopt others with higher wages offered by the mills and factories in the cities. It is

surprising that in view of the gravity of the situation with which the fishery industry is confronted, Mr. Sorley's recommendations for its amelioration and advancement should be conceived in terms which offer no hope for the future development of this important source of national wealth.

It seems to us that the general principles underlying the organisation of an important national concern like the fisheries industry have not been stated in the report from the broad statesmanly point of view. Even the present poor standard of comfort and convenience enjoyed by Indians of average means is due to the raising of the productive capacity of the individual workers. This is accomplished mainly by the specialisation of effort which a particular profession permits and every progressive industrial organisation involves the assemblage and co-ordination of a complete outfit of mechanisms and processes in the successful operation of which an increasing efficiency and trained skill are demanded of the individual. A fisherman has to be inventive and this faculty is instigated and nourished by the research department. With increasing population, the maintenance and improvement of living must obviously depend upon our ability to continue the industrial methods of the community. No industrial progress can be achieved without the constant acquisition of new knowledge which points the way to better control of operations, to new and better processes in evolving new products and new uses of them which extend the market. We must first produce new articles, find out their uses and extend their sale. This principle is applicable to the fisheries as much as to any other industry. The complexity and interdependence of modern industrial organisations and the keen competition between nations demand that any industry,—even fisheries,—must consciously and unremittingly explore the scientific facts and principles and apply them in its operations.

The first step in furthering the interests of the fisheries industry is to improve the professional knowledge and methods of the fisherman and for this purpose the Madras Committee urge on the Local Government the immediate need to undertake the compilation of a fisherman's chart for the South Indian waters comparable with Close's chart for the North Sea. In order that the survey may be completed in ten years, the Committee recommend the purchase of an additional trawler and the appointment of a full complement of technical and scientific staff and a complete equipment of the boats for the expedition. Without a chart and a key to give information to the fishermen about the depth of the waters, nature of the bottom, tides and currents, the occurrence and abundance and kinds of fish in any charted locality and nets and gear appropriate to the occasion, the whole industry must be empirical and success must be fortuitous. Mr. Sorley is not unaware of these facts. He says, "on a full consideration of all the circumstances, I am convinced that there is no case for establishing a Department of Fisheries in Bombay Presidency. At most the Department of Industries might be slightly strengthened. If the fish curing yards are taken over by the Government, the appointment of an Assistant Inspector will be sufficient." This is caution bordering on timidity and the acceptance of these recommendations by the Government of Bombay will absolutely retard the progress of fisheries industry, continually diminish the economic and social status of the fisherman community and certainly deprive the authorities of a fruitful source of income.

The attitude of Mr. Sorley towards fishery research is definite. He advises scientific research in the "narrower sense" of the word "Science" and "there is no need for the Bombay Government to indulge in general scientific research on fisheries". If, however, research is to be adopted as a policy, he observes that "it should be confined to certain definite questions likely to promise results of economic importance within a reasonable time and it would be advisable to fix a time limit within which research must be completed." This suggestion has the advantage of "a contract being signed with the scientist engaged for the investigation of definite problems placed before him." This is not all. "Government should itself control exactly from the start the terms of reference, the system of investigation and the amount of public money to be expended each year." In the earlier sections of the report, Mr. Sorley points out that "the Madras Fisheries Department has, in the course of its existence, by means of its bulletins, collected a mass of information of high scientific value relating to all aspects of the fishing industry and fishing research. In Bombay nothing has been done in this way and scientists have to start from Day's

'Fishes of India'. However, the fishing development is to be undertaken according to Mr. Sorley without much expenditure of public money, but by private individuals, public bodies, learned societies, the University and Government and with such inter-provincial and international co-operation as is procurable.

The Madras Committee observe that "it is evident that research is urgently needed in every branch of the department's work before any further appreciable progress can be made." Dealing with the reorganisation of the work of the Department of Fisheries, the Committee point out that "the most important part of it which is immediately needed is extensive research of a two-fold nature—(1) relating to observations on which the preparation of a fisherman's chart should be based; (2) relating to the correlated biological observations." For the successful prosecution of scientific research on fisheries recommendations are made for the appointment of a highly qualified staff: a Fisheries Biologist, a number of assistant biologists for marine and fresh water investigations, a biochemist and a chemical engineer on suitable salaries, each officer to be provided with fully equipped laboratories. In making these recommendations "the Committee fully realise the magnitude of the expenditure involved, but as the branch of work has so far resulted in substantial profits to Government" the proposals are expected to cover the entire cost of the maintenance of staff and research stations and accordingly the Committee have no hesitation in suggesting the costly developments for adoption by the Government as their approved policy.

Mr. Sorley's recommendations are entirely out of date and are based on a fatally wrong conception of science and research. A 'narrow' and 'broad' sense of science is distinctly mediæval. The fisheries problems are numerous and complex and refer to Oceanography, Meteorology, Marine Biology, Biochemistry, Dietetics, Engineering, Statistics, Technology, Socio-economics and Subsidiary Industries, and research in every one of these departments must be intense and continuous: we doubt if any one of these problems can be isolated for study on a contract basis and the last word pronounced on the completion of its investigation. It is totally irrelevant to suggest that Government should direct scientific research. It is untenable to suppose that fundamental research, on which industrialt research is to be based, can be entrusted to private individuals and public bodies to be carried on without expenditure of public funds. The Universities can supply biologists to undertake fishery research, but must refuse to accept the responsibility of conducting investigations into the complex fishery problems. Even the fundamental research of the highest type is best conducted in the laboratories of Fisheries Department and on board the trawlers. The quality and effectiveness of all industrial research rise in proportion to the use it makes of the facts and principles of pure scientific investigations. None of the enquiries can be conducted on the basis of Mr. Sorley's recommendations.

A great deal of information on practically every one of these subjects is rendered available by the investigations of the Fisheries Department of Japan and European countries where biological research is regarded as of supreme importance and its initiative and guidance devolve on State Department of Fisheries. In India every problem is of importance and the knowledge accumulated by the Fisheries Department, Madras, on the one hand and that, on the other, obtained by the officers of the Zoological Survey of India would form a suitable starting point of fresh investigations. Commercial expansion of fisheries as an industry is possible only by concentrated work on technological, chemical and engineering problems, with special emphasis on researches on the comparative nutritive value of marine and fresh water fishes consumed as food by the Indians. The problem of preservation and rapid transportation of marine fishes in a tropical climate is fraught with peculiar difficulties and the processes of freezing the animals in refrigerators and drying them with salt, and canning them in sealed tins, require investigation in respect of the vitamin content of specimens so treated under the Indian climate. On the chemical side, the possibilities of hydrogenation of fish oil which may be converted into wholesome edible fat or into solid fat valuable as soap stock and analyses of fish guano and other fertilisers with reference to the Indian soils and plants should receive simultaneous attention with a view to supplying the Indian agriculturist with sufficient quantities of cheap manure.

Pasteur's germ theory of disease will sooner or later be supplanted by the food theory of disease. The problem of feeding

the rural population is of all-India importance and the responsibility of initiating investigations into the nutritive and therapeutic value of the various articles of food used in India must belong to the Central Government. It does not seem that the broad aspects of the question—the problem of making the production of food in the country equal to the necessary consumption,—has formed part of the definite policy of the executive of administration. In India there is no equitable distribution of food on a physiological basis and an investigation into the national requirements of calories and proteins and to what extent the produce of the land is to be supplemented by other sources in order to maintain the people at the maximum physical efficiency is a problem for the consideration of the Government of India which cannot escape from the obligation of providing the people with the means of educating and feeding themselves. It is not improbable that the transformation which is being gradually introduced into the diet of the orthodox communities will become more pronounced with the increase in the number of young men returning from an education abroad and when the people realise in an increasing measure the advantages of a mixed diet for the preservation of their health, protection of the sanctity of their homes and defence of their country, we have little doubt that fish and fowls will be more generally added to their daily rations. In the meantime the agricultural population, the artisans, and others engaged in hard manual work should have a sufficient supply of cheap fish and if the means of distribution is developed, the consumption of this article of food will increase ten-fold.

The increased expenditure of public funds involved in the establishment of Fisheries Department in all provinces, with research laboratories under the control of the Central Government would be perfectly justified, because it will provide employment for a large number of highly trained scientists who at present are unemployed and when the Government take over the management of the subsidiary industries and develop them, educated young men can find useful occupation in larger numbers. It is not so much the social stigma supposed to be attached to the profession of fishermen that is keeping back others from engaging in it as the hazard to life and the terrors of an angry sea that make people prefer to eke out a precarious existence on land. The simplest and the easiest mode of elevating the social and economic position of fishermen and of removing from the minds of others false notions of the dignity of labour is to take out school children on weekly excursions on the sea and large rivers, and enable them to watch the fishing operations. As soon as they get over the inconveniences of sea-sickness, and feel braced up by the sea breeze, they will shake off the fear and become interested in the capture of fish whose colour, form and variety will amuse and instruct them. They should be taken to visit the industrial centres where fish is smoked, salted, and canned and by-products are prepared. After repeated visits they will get used to the offensive smell and unfamiliar sight of the place and if they are encouraged, they will be delighted to lend a helping hand in the operations. Besides being part of their education, the interest in the sea and its contents so early implanted in the young mind, may develop later into a professional passion. The prejudices of an adult mind are hard to remove, but the juveniles form an excellent material for training for any walk of life. The increased association of other caste men with the profession of catching fish will tend to its elevation. If the Departments of Education and Fisheries are under the control of the Central Government, a comprehensive scheme of co-operation on a nation-wide scale with sufficient provision of finance for effectively carrying it out, can be formulated and put into execution. The money invested in a programme of this description will be in the nature of profitable investment.

Mr. Sorley's report without its recommendations in respect of organisation of the Fisheries Department, the expansion of the industry and the institution of scientific work including general research in all branches of the department, is certainly a clever document and the timid suggestions made in regard to the fishery development must be due to an inadequate appreciation of the fact that "research is the mother of all industries and it may even dispute with necessity for the parenthood of invention." We hope that the Bombay Government will draw lessons from the Report of the Madras Committee far different from those indicated by Mr. Sorley and that the Central Government, realising the immediate importance of taking over the Fisheries Department

under their jurisdiction, will appoint a Commissioner of Fisheries for co-ordinating the efforts of the local governments and elevating the industry into an effective instrument for enriching the social and material wealth of the Indian Empire.

Alfred Bernhard Nobel.

(1833—1896.)

OCTOBER 21, 1933, marks the Centenary of the birth of Alfred Nobel. At the age of sixty, in 1893 when the University of Upsala conferred upon him the honorary degree of Doctor of Philosophy, Nobel at a request for his autobiography wrote thus: "The undersigned was born at Stockholm on 21st October 1833; he acquired his knowledge in private studies and did not attend any secondary school. He devoted himself particularly to applied chemistry and discovered explosives known under the name of dynamite and smokeless powder called ballistite and C. 89. Since 1891 he has been a member of the Royal Swedish Academy of Sciences, and is also a member of the Royal Society (London) and the Societe des Ingenieres Civils in Paris. Since 1880 he has been a Knight of the Nordstjarne Order. He is an Officer of the Legion of Honor. Sole publication: a lecture in the English Language which was awarded a silver medal."

Nobel's passion for researches on chemical explosives is the result probably of his association with his father Emmanuel Nobel who at an early age went over to St. Petersburgh where the father and son were engaged in the construction of submarine mines and torpedoes. Some of the wonderful achievements of the modern engineers are rendered possible by the invention of the explosive compound dynamite which is distinctly a land-mark in the progress of civilisation and probably the greatest next to the Printing Press. Dynamite was followed by blasting gelatin and years later by ballistite, one of the earliest of the nitroglycerin smokeless powders, the precursor of cordite. These inventions, including artificial India rubber, brought Nobel an immense fortune and also vexations of law suits. His exploitation of the Baku oil fields, in collaboration with his brothers, added considerably to the former. He held 129 patents in Britain and controlled fifteen explosive factories in different parts of the world and left behind him £ 1,680,000.

This amount is the foundation of five annual prizes of about £8,000 to £10,000 to be awarded for the most important discoveries in Physics, Chemistry, Physiology or Medicine and also for literary works of an idealistic tendency and for distinguished public service in the cause of Peace. The benefits of the foundation are open to all nationalities and are without restrictions of sex. The first four are awarded by the Swedish Academy and the fifth by the Norwegian Storthing. Dr. Rabindranath Tagore and Sir C. V. Raman are among the recipients of this greatest international honour.

Though Nobel discovered explosives he was a sensitive, nervous man always poor in health. He remained a bachelor and was of lonely disposition. He had a great horror for wars and is reported to have said, "I wish I could produce a substance or a machine of such frightful efficacy for wholesale devastation that wars should thereby become altogether impossible." Is there no other way of abolishing wars ?

Biology: its Importance in Modern Education.

By P. W. Gideon, M.A.,
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(Continued from Vol. II, No. 3, page 85.)

TO-DAY the world has realised that the human race is probably at the dawn of racial suicide, due to a world-wide ignorance of the common laws necessary for the prevention of disease and the eradication of important animal and plant pests.

Almost the whole of the literate and educated population of the world think man the dominant race amongst living things. It is only the very small minority who know the tremendous warfare raging in life's struggle for existence, and see the human race just able to hold its own. The human stock is no more dominant than the other stocks of animals and plants, the only difference being that while the human race is conscious of its dangers and consciously tries to get the better of its enemies, the rest of life enters into this tremendous struggle, unconsciously. It is well for us to remember that our powers of reason and consciousness to dangers around us are our only weapons in this struggle, whereas the remarkable powers of regrowth, the enormous powers of reproduction, protective colouration, and mimicry are a few among the millions of adaptive devices Nature has bestowed on her children in preserving the individual for the perpetuation of the race.

To man alone is given the power of reason and he alone is conscious of his position amongst living things. To be ignorant of this power or to fail to use it, is to lose hold of our place in life's struggle. Herein lies our real danger. Almost the whole human population is in total ignorance of the dangers that beset us, and fall an easy prey to enemies, millions dying chiefly through disease.

In our present state of civilisation, where the efficiency of specialisation has reached a very high standard, modern man has become a one-sided being, leaving the problem of disease and its cure to a small body of specialists—the medical men. Whatever may be the argument for leaving the various arts and crafts to specialists, the entire leaving of the problem of disease to a small body of specialists has been man's undoing; since the relegation of such powers interferes with man's fundamental rights in his struggle for existence. In Nature's struggle, it is the race as a whole that has to fight and no amount of specialisation of a group of individuals to cope with the natural dangers threatening the race can be of much avail. There must, of course, be a body of men trained as specialists for the detection, prevention and eradication of man's enemies, but side by side, there must be the means for educating the whole of humanity in the essentials of these discoveries, which would provide an escape from the penalties of ignorance.

The imparting of such knowledge is only possible through a study of Medical, Economic and Social Biology, and a careful selection of such essential features as would have a practical value in protecting the health of every citizen and making him take a living interest in all the efforts used for fighting the annual drain of human life and wealth. This should form a necessary part of every nation's educational policy.

The recent National Conference organised by the British Social Hygiene Council to discuss the place of Biology in education, emphasised the necessity for the education of every citizen in the understanding of biological ideas so that problems of industry, economics and population should not be beyond our control. It also stressed the point that in every stage of the education of both boys and girls Biology must have its place. The present demand all over the world is for an education that would equip every citizen with sufficient knowledge of the cause, spread, and prevention of the common and dangerous diseases, and of the animal and plant pests which cause damage to crops, livestock and other goods of value to mankind; that would encourage the production of offspring among those people most richly endowed by Nature, and that would devise practical methods for cutting off the inheritance of persons who are socially inadequate.

India inherits the usual disadvantages that a tropical climate bestows. She is the home of many diseases and unfavourable conditions. And the education of her children towards a biological outlook, that would

encourage and support every effort in the eradication of all factors detrimental to the progress of humanity, should engage her immediate attention.

The work of educating the public must primarily rest with the educational bodies throughout India. The study of Zoology and Botany, stressing such points as are essential to human welfare should be of vital importance to every boy and girl, man and woman leaving our schools and colleges. Biology should be one of the compulsory subjects in the Primary, Secondary, and even the first two years of collegiate education.

At the recent Matriculation Examination of the Bombay University, out of 17,000 candidates, only 63 offered Zoology and Botany, and 171 Physiology and Hygiene as their optional subjects. The remaining 16,750 students—the majority of whom would perhaps never again come into contact with educational facilities—must plod their tragic way through life with practically no idea of life and its dangers, the cause of disease, its transmission, cure, prevention and eradication.

Imagine 17,000 students facing life's dangers with a knowledge of History, Geography, Algebra, Geometry and Arithmetic. While in no way trying to minimise the value of these subjects, this is only an instance to show how, in the entire exclusion of Biology as one of the compulsory subjects, we have failed to recognise the true values of things.

The universal realisation of the need for Biology in the educational policy of every nation will have a profound and far-reaching effect in the world of the future, when health and prosperity will take the place of disease and poverty.

Lacertilian Respiratory Mechanism.

By C. P. Gnanamuthu, M.A., F.Z.S., *Madura*.

THE part played by the buccal floor, and therefore the hyoid and its muscles, in co-operating with the thoracic respiratory mechanism has been minimised if not lost sight of by previous workers like P. Bert, C. Heinemann, E. Siegurt and E. Goppert. An estimate of the exact character and degree of buccal participation in pumping air in and out of lungs is necessary to understand reptilian respiration as a whole and to trace its evolution from the mechanism of pulmonary ventilation of amphibia.

The present note on this subject deals with the respiratory mechanism of only three lizards—a geckon, a varanid and an agamid. The buccal floor of members of geckonidæ rises and falls rhythmically and it can be easily noted that these oscillations are as frequent as the expansion and contraction of the chest. That those movements of the buccal floor are not passive—not the secondary effects of the going out and coming in of air from the lungs—was proved by the following experiment. A Geckon (*Hemidactylus* sp.) was tied down to a board and about 0·3 to 0·5 c.c. of Novocain (Bayer Meister—Lucrius) was injected subcutaneously into the throat region. The trachea was cut when the part was completely narcotised. Movements of the buccal floor continued as regularly and as frequently as those of the thorax, though the air from the thorax could no more enter the buccal cavity. This shows that the buccal floor movements form a feature of the respiratory mechanism as active and primary as the contraction and dilation of the thorax.

It is interesting to watch the buccal floor lower when the thorax dilates and rise when the chest contracts. The fact that the buccal cavity and the thorax contract together furnishes additional evidence to prove that the buccal movements are active and independent of those of the chest. The movements are so quick that the fact that they do not alternate may not be easily detected unaided. To facilitate observation the following apparatus was devised. A lizard was tied down to a board with the ventral side upwards. Small strips of glove rubber glued to the lower ends of pieces of wires were placed, one on the chest and another on the buccal floor. The upper ends of the vertical wires communicated the movements to the short arms of long light wooden levers. Each lever had a knife edge fixed to it, and this knife was allowed to rest in a 'V' shaped groove of a wooden piece clamped to a stand. The lever was perfectly counterpoised about the fulcrum and care was taken

that the lever did not exert too much pressure on the buccal floor. When the buccal floor (or the chest wall) rose and fell, the tips of the levers dipped down or tilted up. A thin copper wire was previously wound round the long arm of each lever from the fulcrum to the tip. The free end of the wire at the tip of the lever was made to just touch another piece of copper wire (fixed to a stand) whenever the tip of the lever was lifted. The other ends of these two wires were connected to the poles of an electric battery so that a circuit was completed whenever the free ends of the two wires touched. Electric bells were introduced into the circuits and their sounding facilitated the observation of the synchronous movements of the levers connected to the buccal floor and the thorax. Later styles were fixed to the hammers of the two electric bells and their vibrations were recorded on smoked paper revolving round two drums. The record obtained showed that the contacts made by the levers connected to the buccal floor and to the thorax were simultaneous. This method of recording the buccal and thoracic movements had to be resorted to because the mouth floor and chest wall movements appeared too weak for ordinary graphical records.

The above experiments clearly show that the buccal cavity and the thorax contract together and dilate together and that these movements of the buccal and thoracic wall are both active and due to the effort of independent muscles. The rôle the buccal floor plays in the respiratory mechanism appears to be this: Owing to the weak character of the muscles of the buccal floor, the strong contraction of the thorax, expelling air from lungs would bring about the inflation or lowering of the mouth floor. When next the thorax relaxes the air inspired would be this impure air in the buccal cavity especially when the thoracic contraction and expansion follow each other so rapidly. This is avoided by the active and simultaneous contraction and expansion of the mouth floor. When the thorax contracts, the tongue and floor of the mouth are raised up through the aid of the transverse and hyoid muscles and the vitiated air from the lungs is thus expelled direct.

In calotes and varanus, however, the buccal cavity appears to participate only during the extraordinary respiratory movements. If a calotes or varanus were tied down to a board with the ventral side upwards and if the throat region were watched carefully, it will be seen to move very slightly. These movements, however, alternate with those of the thorax. If a thread is stitched through the skin in this region and attached to a pin driven close to the fulcrum of a lever (described before) these movements can be recorded. That these movements are passive and secondary and due to the air going out and coming into the thorax, can be proved by cutting the trachea after narcotising the region by a subcutaneous injection of novocain. The movements cease. A little later, however, when this operation brings on laboured respiration the buccal movements can be seen to be spasmodic and vigorous and to synchronise with the movements of the thorax. The same result could be obtained by plugging the nostrils of a calotes with wax or by tying the thorax with a piece of twine and thus restricting its movements. By means of levers which have styles attached to their tips, the movements of the mouth floor and thoracic wall were recorded on smoked paper. The graphs showed that the mouth floor and chest wall contracted or expanded together during laboured respiration. (While these records were made, the mouth of the calotes was kept open by a piece of stick thrust between the jaws. By this means the expired air was prevented from affecting the buccal movements.)

What little passive dilation and contraction there can be seen in normal breathing is apparent only in the back part of the throat and is confined to a very narrow area of it because of the thick muscles of the hyoid and buccal floor. As the disadvantage of a thin walled, easily inflated and deflated buccal cavity is thus obviated, the buccal floor does not perform any movement during normal respiration. During laboured respiration, however, the buccal floor and tongue being elevated makes the expired air go completely out of the body, while their being depressed during the expansion of the thorax, facilitates the sucking in of fresh air.

Letters to the Editor.

The Panjal Trap.

THE volcanic origin of the Panjal Trap of Kashmir was first established by the researches of Lyddeker and McMahon in 1883.[1] In his revision of the geology of Kashmir C. S. Middlemiss briefly referred to the Trap as 'genuine old basic lava flows'[2]. The microscopic characters have been described in some detail by D. N. Wadia. According to him 'the lava is a basic variety of augite-andesite'[3].

The most easily accessible and prominent outcrops of the Trap occur in the neighbourhood of Srinagar where they form the high peak of Takht-i-Suleiman and the precipitous scarp at the back of the Mogal Gardens. It is easily seen along the road leading from Srinagar to Anantnag up to a distance of 5½ miles where the Jhelum comes close to the hill. Here the trap is extensively quarried as a building stone. During a recent visit to Srinagar the authors observed that the rock was often of a very light colour and gave low values of specific gravity common to rhyolites and trachytes. At many localities clear phenocrysts of quartz could be seen in hand-specimens, especially with the aid of a lens.

The accompanying figure is a microphotograph of a specimen taken from the quarry at Panthachuk, between the fifth and the sixth milestone, south-east of Srinagar. It shows euhedral to sub-hedral phenocrysts of quartz which have often suffered corrosion in the magma. These crystals also show original fine cracks which appear as white lines in reflected light. Phenocrysts of simple-twinned felspar are present and are turbid due to kaolinisation. The groundmass is micro- to crypto-crystalline and is of a felsitic character. Traces of a chloritic mineral and iron ore are present. In hand-specimens the rock is compact and has a grey colour with minute white and black spots of felspar and chlorite respectively scattered sparingly through the mass. Small phenocrysts of quartz are also visible under a lens. Its specific gravity is 2·63. A partial chemical analysis carried out by the usual method gave 78·89 per cent. of silica. The rock is clearly a quartz-felsite or rhyolite.

Rhyolite, Panthachuk, near Srinagar, Kashmir. × 20.

The general description of the Panjal Trap given by D. N. Wadia[4] applies to the rocks of this region except that granular augite is not seen as an essential constituent and the lavas often show phenocrysts of quartz. Pitchstone of a dark colour is not uncommon and shows a superficial resemblance to basalt. It is interesting to find that at least some of the lava-flows of the Panjal Trap are definitely rhyolites and not augite-andesites, and it is doubtful whether basic or sub-basic lavas occur in any quantity in the neighbourhood of Srinagar. Detailed study of the lavas of this formation round the Kashmir valley is being carried out by the second author of this article.

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September 1, 1933.

[1] *Mem. G. S. I.*, **22**, p. 218.

[2] *Rec. G. S. I.*, **40**, Pt. 3, p. 235, 1910.

[3] D. N. Wadia, *Geology of India*, p. 360, 1926.

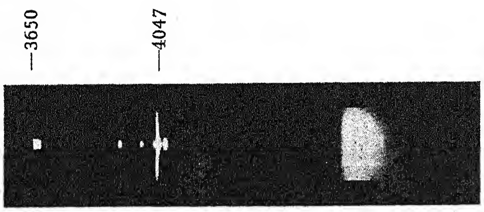
[4] *Op. cit.*

On the Incoherence of Fluorescent Radiation.

ACCORDING to the generally accepted ideas regarding the excitation of fluorescence by light waves, we should expect the fluorescent radiations starting from neighbouring molecules in the medium to be incoherent in

phase. The following experiment demonstrating the incoherence may be of interest. The principle of the experiment, originally due to Wood, is as follows. A rectangular glass cell containing a solution of fluorescein, was placed at some distance in front of the slit of a spectrograph. The light from a distant small mercury arc, after passing through a condensing lens and the fluorescent solution, came to focus on the slit of the spectrograph. A blue violet filter placed before the arc served to cut out all the radiations in the incident light, of longer wave-length than λ4358.

Since the directly transmitted mercury radiations come to a sharp focus on the slit of the spectrograph, they will give rise to *very short* spectral lines on the photographic plate. If the fluorescent radiations from adjacent molecules were coherent in phase, these fluorescent radiations also would come to focus on the slit of the spectrograph, and give rise to a continuous spectrum having, like the spectrum of the directly transmitted light, very little extension parallel to the length of the slit. If on the other hand, the radiations are incoherent, the fluorescent band will widen considerably along the length of the slit. The accompanying spectrogram shows very clearly that the latter is the case.



The experiment was repeated with incident linearly polarised light, and the two principal vibrations of the partially polarised fluorescent radiations in the forward direction (parallel and perpendicular respectively to the vibrations in the incident light) were separately found to be also incoherent. Further with incident circularly polarised light the fluorescent radiations in the forward direction were found to be unpolarised.

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September 5, 1933.

S. M. MITRA.

Seasonal Variations (Sexual Cycle) in the Testis of *Rana tigrina*.

BOTH lower and higher vertebrates offer a fruitful field for research regarding (1) seasonal variations in their organs of reproduction, and (2) an interesting line of investigation with a view to finding out whether the periodic activity of their gonads could, in any way, be correlated with the hormonic activities of their ductless glands. Oslund[1] has published a useful summary of the work done so far as the year 1925. Since then Bissonnette[2] has published a series of papers on the sexual cycle in the starling and Blount[3] has investigated the seasonal cycle of the interstitial cells in the testis of the horned toad. The difficulty of obtaining specimens of the animal under investigation throughout all the months of the year in other parts of the world may partly explain the paucity of papers on this subject. In this country Asana[4] has been working on the sexual cycle of some Indian lizards.

Frogs have been captured from one and the same locality in the vicinity of Gujarat College, Ahmedabad, at an interval of 8 to 10 days throughout the year. Observations were made and the gonads fixed from five to ten animals every time they were dissected. Adults of almost uniform size were selected.

From the latter half of October and throughout November, December, January and February externally the testes maintain their minimum size, their average volume being round about 4 c.mm. The average length and diameter of the testis during those months were ·4 cm. and ·115 cm.

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[1] Oslund, R. M., "Seasonal modifications in testis of vertebrates. 1928," *Quart. Rev. of Biol.*, **111**, 254-270.

[2] Bissonnette, T. H., "Studies in the sexual cycle in birds. I. Sexual maturity, its modification and possible control in the European starling, 1930," *Am. Jour. Anat.*, **45**, 289-306.

Bissonnette and Chapnic. M. H., "Studies on the sexual cycle in birds. II. The normal progressive changes in the testes from November to May in the European starling, 1930," *Ibid.*, **45**, 307-343.

Bissonnette, T. H., "Studies on the sexual cycle in birds. III. The normal regressive changes in the testis of the European starling from May to November, 1930," *Ibid.*, **46**, 477-497.

[3] Blount, R. F., "Seasonal cycles of the interstitial cells in the testis of the horned toad, 1929," *Jour. Morph, and Physiol.*, **48**, 317-343.

[4] Asana, J. J., "Studies on the sexual cycle of some Indian lizards," *Proc. Nineteenth Indian Sci. Congress*, 1932.

respectively. Their microscopic examination reveals no spermatozoa internally, and in the testes the tubules are almost uniform in shape but small in size. Interstitial cells are very small and few in number. Thus the male gonads seem to be dormant as far as sexual activity is concerned during this part of the year.

From about the first week of March testes begin to increase in length and diameter, the changes being very gradual and the rate of increase very slow for about 20 days. Thereafter the male gonads increase in size at a very rapid rate throughout April and the first three weeks of May attaining their maximum growth during the last week of July, the average maximum volume being 147 c.mm. which is about 37 times greater than the average minimum volume. These external macroscopic changes seem to be correlated with the internal activity of the gonads leading to the production of mature spermatozoa. The tubules grow in size but lose their uniform shape. The interstitial cells correspondingly grow enormously both in size and number.

The regressive changes, the decline in the activity of the gonads, seem to be rather abruptly heralded; and before the end of August testes have decreased in size to a remarkable extent, the average volume being 15 c.mm. Through the whole of September and the first half of October there is a slow gradual decline leading to the attainment of the minimum size with which the cycle started.

Detailed observations including the study of the chromosomes will be published shortly.

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Gujarat College,
Ahmedabad,
Ssptember 1933.

Lint Color in Asiatic Cottons.

IN a review of all the existent literature on the mode of inheritance of lint color of cotton, Ware[1] has shown that in all intervarietal crosses in the New World cottons, expression of lint color can be explained by monofactorial hypothesis while in the interspecific crosses, the segregation for pigmentation is not clear cut and simple. The only references with regard to the behaviour of this character in the Asiatic cottons are by Fletcher[2] and Kottur.[3] The former just mentions that color is dominant over white, while the observations made by the latter on the interspecific cross between *G. herbaceum* and *G. neglectum* have pointed out that the splitting is nearer to 1 : 2 : 1 ratio than any other. But studies made by us at the Cotton Breeding Station, Coimbatore, on the progenies of the interspecific crosses between *G. obtusifolium*, *G. indicum* and *G. herbaceum* gave the interesting ratios of 9 : 6 : 1, 9 : 3 : 4, and 9 : 7 in the F_2 and F_3 generations. These lead us to formulate that the lint color in these cottons is governed by three pairs of factors. This assumption fits in with all the ratios obtained so far. A basic gene X seems to be essential for color production but its presence alone does not induce any manifestation of pigmentation unless it is in conjunction with either of factors K_1 and K_2. The three broad color groupings observed in these cottons, *viz.*, brown, cream and white, thus seem to be the result of interactions between factors X, K_1 and K_2. When all the three are present, the lint is colored brown, while a genetical constitution of either XK_1 or XK_2 results in cream coloration. The absence of both the factors K_1 and K_2 or the basal factor X appears to be responsible for white color. Minute shades of differences are also noted among these phenotypes. Further work is under way to test if they are produced by modifying factors and if the results of all possible crosses will be in consonance with the above assumption.

V. R. AYYAR.
R. B. IYER.

Agricultural College and
Research Institute,
Coimbatore,
September 18, 1933.

[1] *Journal of the American Society of Agronomy*, **24**, 553.

[2] *Journal of Agricultural Science*, **2**, 282.

[3] Imperial Department, *Agricultural Memoirs*, Botanical Series, **12**, 125.

A New Method for the Separation of the Two Components of Amylase.

IN recent years, several methods,[1–5] some very elaborate, have been proposed for the separation of the saccharogenic and the dextrinogenic components of malt amylase.

The present note relates to a simple method of separating the two components.

The new method consists in bringing about a preferential sedimentation in a centrifugal field in presence of alcohol. Malt extract was centrifuged for 20 minutes at 6,000 revolutions per minute in presence of 50 per cent. alcohol. The centrifuge tube was taken out and the centrifugate analysed for the presence of the two components. The activity of the saccharifying component was not impaired but on the other hand, the dextrinogenic component was reduced by about 47 per cent. The results of a typical experiment are given in table I.

TABLE I.

Time in minutes	Control Experiment		Centrifugal Sedimentation	
	Activity of the saccharogenic component in mg. of maltose	Activity of the dextrinogenic component by coloration with iodine	Activity of the saccharogenic component in mg. of maltose	Activity of the dextrinogenic component by coloration with iodine
10	70.2	Blue	73.4	Blue
20	..	Violet	..	Blue
30	104.4	Red	106.0	Blue
45	..	Yellow	..	Violet
60	117.0	..	118.2	Violet
85	..	..	..	Yellow

The concentration of the enzyme, the P_H of the medium and the duration of the experiment are the main factors which determine the successful operation of this method. The optimum conditions for the complete separation of the two components are being investigated.

K. VENKATA GIRI.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
September 20, 1933.

[1] Ohlsson, *Compt. rend. trav. Labr. Carlsberg.*, **16**, No. 7, pp. 1-68, 1926.

[2] Narayanamurti and Norris, *Jour. Indian Inst. Sci.*, **11A**, 134, 1928.

[3] Venkata Giri and Subrahmanyan, *Jour. Indian Inst. Sci.*, **15A**, 107, 1933.

[4] Hamberg, *Biochem. Zeit.*, **258**, 134, 1933.

[5] Keshava Iyengar, *et al.*, *Curr. Sci.*, **1**, 238, 1932-33.

The Homoxyleæ and the Ancestry of Angiosperms.

THE homoxylous genera of angiosperms, namely, *Drimys*, *Zygogynum*, *Trochodendron* and *Tetracentron*, belong to the primitive group Magnoliales of Hutchinson. The gymnospermic vessel-less character of the wood of these primitive dicotyledons is of considerable interest and may be of theoretical importance. A fairly large scattered literature is available on the wood anatomy of these genera, and various botanists have discussed the theoretical bearings of the facts, but a comparative study of all the four genera and an attempt to distinguish them on the wood structure alone has not yet been undertaken. This object has now been achieved to a considerable degree and the resemblances between certain related fossil woods and these primitive genera of dicotyledons have been elucidated in a fully illustrated paper which is now in the press.[1]

The author has also reviewed the more important literature extending over a period of nearly a hundred years, dealing with the anatomy of homoxylous angiosperms and some related fossils. The important observations on the wood anatomy recorded by Goeppert, Groppler, Harms, Solereder, Van Tieghem, Bailey and Sinnott and others have been confirmed in the main points; in addition, the anatomy of the genera *Tetracentron* and *Zygogynum*, about which not much was known before, has been described and illustrated on the basis of the material kindly supplied to Prof. Sahni, by Professors Harms (Berlin) and Record Yale respectively.

The modern homoxylous angiosperms can be conveniently divided into two groups which are rather sharply defined both structurally and geographically.[2]

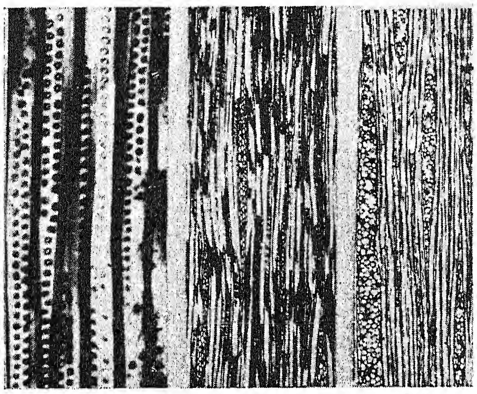
1. The *Drimys* group, comprising the two genera *Drimys* and *Zygogynum* and having several species distributed in the Australasian and American regions. These genera are essentially similar in their wood structure: growth-rings either absent or very faintly marked; medullary rays scarcely or not at all enlarged at the junction of the growth-rings; ray cells more or less uniformly pitted on their horizontal and tangential

[1] Expected to be published in the current volume of the *Journal of the Indian Botanical Society*.

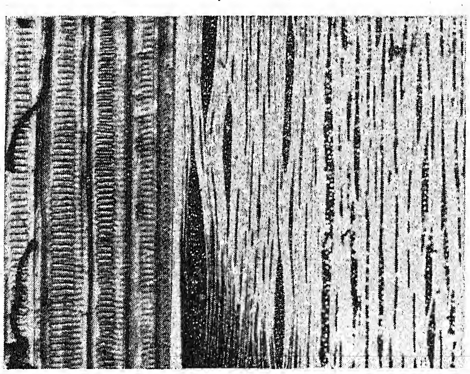
[2] See also Sahni, *Proceedings of the Indian Science Congress*, Patna, 1933.

walls. The usual pitting in the spring wood, both on the radial and tangential walls, is of the multiseriate type (Fig. 1).

2. The *Trochodendron* group, with *Tetracentron* and *Trochodendron*, both monotypic eastern genera confined to China and Japan respectively. Growth-rings well marked, with strongly developed autumn wood and medullary rays distinctly enlarged at the junction of the growth-rings. The usual pitting in the spring wood both on the radial and tangential walls is of the scalariform type (Fig. 2).



1. 4. 3.



2. 5. 6.

1. *Zygogynum* sp. Rad. sec. ×70.
2. *Trochodendron aralioides.* Rad. sec. ×70.
3. *Zygogynum* sp. Tang. sec. ×30.
4. *Drimys* sp. Tang. sec. ×30.
5. *Trochodendron aralioides.* Tang. sec. ×30.
6. *Tetracentron sinense.* Tang. sec. ×30.

All the four genera can also be distinguished by the shape of the medullary ray cells as seen in tangential sections of the wood. Thus: in the *Drimys* group, *Zygogynum* has its multiseriate rays somewhat broader than *Drimys* and the rays consist of large roundish or sometimes angular cells (Fig. 3), while in *Drimys* the shape of the central cells is drawn out into long ovals (Fig. 4). Similarly *Trochodendron* can be distinguished from *Tetracentron* by the fact that the multiseriate rays are broader (6-7 seriate) and the central cells are perfectly round and small (Fig. 5), whereas in *Tetracentron* (Fig. 6) the rays are less broad (2-3 seriate) and made up of long oval cells.

Such a combination of characters has not so far been found in any living angiosperm woods except the few types reviewed in the present paper; among fossil angiosperms the only comparable types are *Homoxylon rajmahalense* Sahni[3] and *Tetracentronites Hartzi* Mathiesen.[4] My sincere thanks are due to Professor Mathiesen who kindly sent a piece from the type specimen, thin sections of which have been examined by me. This early Tertiary fossil from East Greenland very closely resembles the living homoxylous angiosperms, specially the *Trochodendron* group. It is vessel-less and in radial section typical scalariform pitting with transitional stages is seen as described in *Trochodendron* and *Tetracentron*. My thanks are also due to the authorities of the Geological Survey of India who so kindly sent me the type sections of *Homoxylon*. It is an interesting fact that among gymnosperms such a combination of characters has only been recorded in a few Cycadeoids.[5]

The author has briefly discussed in his full paper the theoretical importance of these genera as far as speculated in the light of recent discoveries. He concludes that the magnoliales might have either arisen from a group of fossil angiosperms contemporary with the Caytoniales or directly from some mesozoic Pteridosperms which may, as the recent work of Hamshaw Thomas suggests, be the ancestors of the modern flowering plants.[6]

If the age of *Homoxylon rajmahalense* Sahni, a fossil angiospermous wood devoid of vessels is proved to be definitely Jurassic in the

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[3] Sahni, 1932, "*Homoxylon rajmahalense* gen, et sp. nov." *Memoirs G. S. I., Pal. Ind.*, **20**, Memoir No. 2.

[4] Mathiesen, 1932, "Notes on some fossil plants from East Greenland." *Meddelelser om Groenland.* Bd. **85**. Nr. 4, pp. 1-62.

[5] Wieland, 1916, *American Fossil Cycads*, Vol. II, pl. 35, figs. 4, 5; pl. 36, figs. 2, 3.

[6] H. H. Thomas, 1933, *Phil. Trans. Roy. Soc.*, London,......, 1931; *Ann. of Bot.*, **45**, 647-672.

future, it would indicate a parallel development of the Magnoliales and the Bennettitales, rather than a derivation of the former from the latter. The group Bennettitales is perhaps best regarded as a blindly ending line which may have gradually died out because real angiospermy could not be attained in that group.

In the end I must express my gratitude to Professor B. Sahni at whose suggestion this investigation was undertaken and who placed at my disposal all the material of living as well as extinct homoxylous woods, including some sections prepared by himself and Mr. B. P. Srivastava, M.Sc.

K. M. GUPTA.

Department of Botany,
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September 21, 1933.

Female Gametophyte of *Argemone mexicana* Linn.

IN a communication to the September issue of this Journal, Messrs. Bose and Banerji have criticised some of the work done by the writer on megaspore-formation and embryo-sac of *Argemone mexicana* with these remarks: "His account differs in certain fundamental points from our observations." A careful perusal of their communication, however, shows to me no such points.

The note deals with three main points, the primary archesporium megaspore-tetrad and comparative size of the antipodals and the egg apparatus. I had not seen the first, but from the arrangement of the cells at the tetrad stage of the megaspores, it was concluded that there is most probably a single hypodermal archesporial cell. Bose and Banerji find this presumption to be true. The megaspore-tetrad, I had studied only from one ovary and had found it to be T-shaped. They find not only this arrangement, but the linear one also; the latter is more frequent. It is not the case that they do not find the T-shaped arrangement. What they can very well study now is whether these different arrangements are confined to different flowers or can both arrangements be seen inside the same gynæcium. My observation leads to the first conclusion, but it may be exceptional and not the general rule. The comparative size of the antipodals and the egg-apparatus was studied by me when a good deal of endosperm had been formed. At this stage the antipodals were formed to be 8 to 10 times bigger than the egg. According to the estimates of Bose and Banerji themselves the egg at this stage is about 22μ long and the antipodals 154μ. So there is no great difference between the two accounts, although I found the antipodals to be as big as 200μ or a little more even. I had myself suggested the possibility of the antipodals being much smaller at an earlier stage. This Bose and Banerji really find to be true.

On the whole, what appears to me is that having been working on the subject for a very much longer time and on a much larger amount of material (compared with the two ovaries that I had studied), they have been able to get several more facts—quite a natural thing; and there are no fundamental differences between their observations and mine own.

A. C. JOSHI.

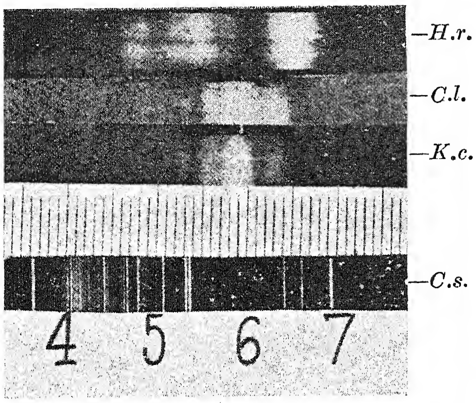
Department of Botany,
Benares Hindu University,
Benares,
October 1, 1933.

Oil-Soluble Vitamins in Some Pulses and Fishes of Bengal.

IN the last (September) issue of the *Current Science* we communicated certain facts regarding the presence of Oil-Soluble Vitamin A in some pulses and fishes of Bengal. The accompanying spectrographs are typical of many more which we have been able to obtain. The difficulties of recording successfully the absorption bands at the right moment are many. A reference may be made to the very valuable paper on "Specificity in Tests for Vitamin A"[1] in which some spectrographs are given obtained with Halibut Oil and $SbCl_3$ reagent. In our spectrographs presented here, just below the wavelength scale is placed Cadmium spark spectral lines. Just above the scale is the absorption spectrum of *Cicer arietinum Oil* and $SbCl_3$ reagent. We have examined two varieties of *Cicer arietinum*—(1) Kabuli and (2) Common—and both gave similar spectra. Above this is an absorption spectrum obtained with a sample of *Cod liver Oil* of approved quality. The uppermost one really consists of two halves—the upper half was taken last and given a longer

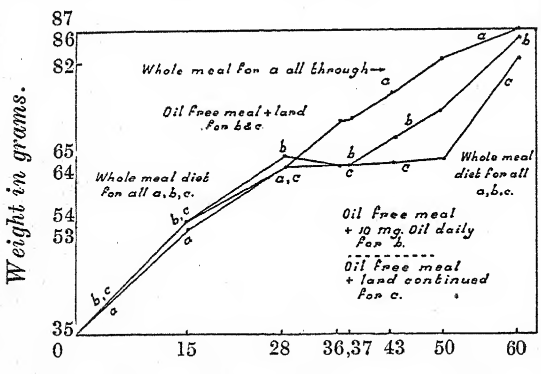
[1] Heilbron, Gillam and Morton, "Specificity in Tests for Vitamin A," *Biochemical Journal*, **25**, No. 4, 1346–66, 1931.

exposure while the lower half was taken just half a second earlier than the last with a shorter exposure; these last ones are the absorption spectra of Hilsha Fish Roe Oil (*Clupea ilisha*).



H.r.—Hilsha roe oil.
C.l.—Cod liver oil.
K.c.—Kabuli chhola oil.
C.s.—Cadmium spark.

The final arbiter is the physiological method. The accompanying curves represent the results obtained with a particular litter of rats. The diet in this case was prepared in the Bose Institute Laboratories



Days after which weights were recorded.

and consisted of Kabuli Chhola Meal (*Cicer arietinum*) and made oil free as required. It may be mentioned that similar results have been obtained with B. D. House products. Several litters of rats have given similar (more or less) results. Fat-free diet producing Xerophthalmia and unkempt hair, particularly on the back parts above the hind legs, are soon noticed and have been cured by the application of daily doses of *Cicer arietinum* Oil (and compared side by side with Cod liver Oil and Hilsha Fish Oil). A general weakening of the legs, particularly hind legs, and an increased thirst for water is also observed in rats kept on fat-free diet.

In the particular set of curves which represent the results, all the young rats *a*, *b*, *c*, on the day they were put on whole meal diet, weighed each 35 grams. On the 15th day after the starting *a*, which by the way was kept as control all through on whole meal diet, weighed 53 grams; both *b*, and *c* each weighed 54 grams. From this point *b* and *c* were kept on fat-free (oil free) *Cicer arietinum* diet with lard to replace the oil. From the 28th day the increase in weight stopped and the weight became steady at 64 grams. From the 37th day *b* was given a daily dose of *Cicer arietinum* oil instead of lard and began to show gain in weight, while *c*, which was still kept on oil-free+lard diet showed no change. This was continued till the 50th day, when all the three sets were again given whole meal diet as at the commencement of the observations. Ten days after, on the 60th day, there was gain in weight in all the three and remarkable recovery in *c*.

Further details will be published in due course in the *Transactions of the Bose Research Institute.*

H. N. BANERJEE,
N. C. NAG.

Calcutta,
October 5, 1933.

Erratum.

Current Science, Vol. II, No. 3, September 1933, page 95, left-hand column, lines 32, 33, 35 and 37—

for "μ" *read* "mμ".

Recent Researches on the Ætiology of Goitre.*

THE past few years have witnessed considerable progress in the study of this highly important problem. They have shown more vividly than at any earlier period that the causes of goitre are multiple and their effects manifold. Some of the causes are now definitely known. They are essentially nutritional and hygienic. Their combination in various ways may give rise in different persons and different localities to diverse types of goitre of both sporadic and endemic kinds. True endemic goitre with its sequelæ of congenital goitre and cretinism would appear to be due to a summation of these causes and to-day it can be said with greater assurance than ever before that the disease can be prevented by attention to fundamental principles of nutrition and of personal and social hygiene.

It is now well established that the physiological attributes of the thyroid gland are similar in all the higher animals: observations made on one species are therefore applicable to others, due regard being paid to different conditions of life, food, metabolism and such like. Since smaller animals are more convenient to work with than bigger ones, the more recent investigations, particularly those of McCarrison and his co-workers at Coonoor, were carried out chiefly with pigeons, rats, guinea-pigs, rabbits and monkeys. They related mainly to (*a*) the biometric study of the normal thyroid gland in different species of animals, (*b*) statistical study of experimental data with special reference to the effect of diet on thyroid gland, (*c*) experimental production of lymph-adenoid goitre, (*d*) study of goitrogenic agents associated with food materials and anti-goitrogenic substances other than iodine, and (*e*) the effect of insanitary condition on the thyroid gland and the interactions of this condition with faulty food in the causation of goitre.

The weight of the thyroid gland in any animal depends on a number of factors such as locality, sex, sexual activity, season, individual idiosyncrasy, sanitary condition and diet. Of these, diet is the most important, variability being at its lowest in animals on perfectly constituted diet and at the highest in those receiving diet of diverse character or possessing goitrogenic properties. The weight of the thyroid gland is not by itself a useful indication: the observations of McCarrison and Madhava have shown that the ratio ('r') of the organ weight to the body weight is a more definite index of the conditions of the thyroid at any particular stage. If the mean values of 'r' corresponding to selected intervals of body weight are plotted out, there may be observed a gradual increase of 'r' values in the earlier stages of growth culminating in the attainment of a maximum point after which the curve turns round into a subsequent stage of progressive diminution of such values. The curve thus obtained is a highly characteristic one which the authors have, in picturesque phraseology, designated "The Life-line of the Thyroid Gland". The height, the evenness (or slope) of movement and even the shape of the life-line is affected by a variety of factors, so that by following the course of the curve it is possible to determine the response of the thyroid to any particular treatment.

Goitre surveys conducted by the method of visual examination are inadequate: not only the breadth of the neck but also the development of the body must be taken into consideration. The apparent evidence of goitre in school-children is not a true criterion of the endemicity of the disease: in fact, many of the so-called childhood goitres do not represent the diseased condition of the thyroid gland at all, but the normal expression of the place of the organ in relation to the growth and development of the children concerned. If this fact be recognised, a considerable amount of confusion regarding the ætiology of endemic goitre would be removed.

The importance of diet in relation to goitre cannot be over-emphasized. It may, in fact, be stated as an axiom that the more perfect the diet, the more stable is the thyroid gland in point of size and the less likely is goitre to occur. In this connection it should be pointed out that excess of certain ingredients possessing anti-goitrogenic properties may lead to goitrous symptoms. Thus excess of whole milk is harmful, the fat thus taken disturbing the fat / iodine ratio which, in turn, affects the thyroid gland. Radiostelium (containing vitamins A and D) has a tendency to slightly increase the ratio of thyroid weight to body weight either when it formed the sole source of those vitamins or when added to diets ill-balanced with respect to calcium and phosphorus. A scorbutic diet (deficient in vitamin C) is also harmful. Deficiency of suitable protein or certain mineral salts or some enzymes and excess of carbohydrates would also appear to contribute their share to the general disorder of the thyroid gland. On the other hand, starvation causes marked reduction in both the weight and the size of the thyroid.

Lymph-adenoid goitre has now been produced under experimental conditions in albino rats. It has been observed in the case of rats fed on synthetic diets the main fault of which is one of vitamin-deficiency. This type of goitre can occur in spite of adequate ingestion of iodine. The ultimate causes of the origin of lymph-adenoid goitre in rats is still not fully understood, but there is definite evidence to show that a perfectly constituted diet affords complete protection against it.

The frequent association of goitre with limestone rocks and with drinking water rich in lime has long been known. Recent researches have shown that the action of lime is bound up with a relative deficiency of iodine and phosphates. Sometimes the reverse may also happen, excess of iodine combined with poor supply of calcium also leading to goitre in experimental animals. It would thus appear that the disturbance of calcium / iodine balance in either direction is an important factor in the genesis of goitre. Addition of phosphate is useful in reducing the adverse effects of excessive amounts of calcium, but cases are on record to show that there is need for balancing of diet by addition of milk even after the calcium/phosphorus imbalance has been corrected. There is also evidence to show that excess of calcium or

* Summary of report presented by Col. Sir R. McCarrison, K.C.I.E., M.D., D.SC., F.R.C.P., to the Second International Conference on Goitre held at Berne during August 1933.

mineral imbalance may interact with vitamin and protein deficiency causing thyroid disorder.

Studies on the effect of iodine on thyroid tissue grown *in vitro* have shown that increasing dosages up to 25γ in 100 c.c. have a stimulating effect on both the growth and metabolism of the cells. Higher concentrations of iodine increase the rate of metabolism without favouring growth: in such cases the life of the cells is also correspondingly shortened. Those results afford conclusive proof to show that small doses of iodine have a direct, stimulative action on the thyroid gland.

Recent investigations have shown that association of goitre with low iodine content of soil is not invariable: nor could any correlation be observed between the iodine content of drinking water and the incidence of goitre. Furthermore, while a low content of iodine in food is one of the factors leading to goitre, yet addition of iodine to a well-constituted diet may not always prove beneficial. Though iodine is a powerful anti-goitrogenic agent, it is not always so potent in its action as thymol, manganese chloride or thyroxine. There is considerable evidence to show that though deficiency in iodine is one of the causes favouring particular types of goitre, it is not the essential cause of every form of that disease.

Following the observations of Clawson, Chesney and Webster and later, of Marine and his co-workers an extensive series of investigations were carried out by McCarrison and his associates on the causation of goitre by cabbage. The results have shown that although cabbage has a goitrogenic potency, yet its intensity is affected by various factors. It changes with season: its effect varies with individuals. The inconsistency is partly accounted for by the fact that cabbage also contains antigoitrogenic constituents, which are mostly present in the juice. The goitrogenic agent is insoluble in water but is extracted by ether and other solvents. It is heat-stable and is resistant to oxidation in the air. Certain food materials such as bran enhance the goitrogenic potency of cabbage, while others such as carrots, legumes and fresh green grass help to diminish it. Certain chemicals like sodium chloride and radiostelium enhance its action while others like iodine, thymol, manganese chloride or thyroxine either diminish or wholly counteract its effects. Addition of iodine to drinking water prevents the occurrence of cabbage goitre. The goitrogenic action of cabbage is not, however, due to deficiency of iodine in that vegetable. There is some evidence to suggest that the harmful constituents are of the nature of cyanogen compounds.

More recent researches have shown that several other substances are also goitrogenic in their properties. Thus, Marine and his collaborators have incriminated other members of the *Brassica* family and some *Cruciferæ* as goitrogenic food-materials. McCarrison and his co-workers found soya-bean, ground-nut (both defective in Vitamin C) and sorghum (*Andropogon*) to be also goitrogenic. Such food-materials do not, however, cause the disease unless they are taken in large quantities. If taken with a balanced diet, their effects are neutralised by other vitamin-bearing constituents. Thus, whole milk, carrots, fresh green grass and sprouted legumes are anti-goitrogenic in their properties. It has been suggested (Marine *et al*) that the anti-goitrogenic principle in certain food-materials is hexuronic acid: in view of the increasing evidence to suggest the identity of the latter with Vitamin C, it would appear that substances rich in that vitamin would be anti-goitrogenic in their properties.

Balanced food by itself is not a safeguard against goitre. The investigations of McCarrison and his co-workers have shown that insanitary conditions may also lead to the development of that disease in animals. There is no definite evidence to show whether any of the products formed as the result of the fermentation of the excretal materials and food remnants is by itself responsible for the effects observed. On the other hand, combination of neutral diet with the aqueous extract of fermented compost in insanitary cages led to nearly 60 per cent incidence of true goitre while the controls receiving the diet alone showed none, thereby indicating that the extract had a definite predisposing action. This suggestion was supported by histological examination of the sections of the glands which showed they were subject to degenerative changes corresponding to those observed in systematic infections and severe toxæmias. These observations together with those of other workers, particularly those of Turcu, Womack, Cole and Heidmann, Anderson and Twort would show that a variety of substances, both chemical and microbic, are capable of giving rise to goitrous changes in the thyroid gland.

It may be concluded from the above that apart from influences such as hereditary predisposition, individual idiosyncrasy, puberty and pregnancy, there are some evident and conjunct cases of goitre:— (1) Increased demand on the part of the organism for the products of the thyroid gland, such as may be occasioned by conditions which depress tissue-oxidation or by excess of certain substances (fats, lime and the goitrogenic agent in some vegetables) in the food. (2) Faulty nutrition of the gland, with depreciation in the functional efficiency of glandular epithelium and increased susceptibility to the action of toxic and microbic agencies: such as may be occasioned by deficiency of suitable protein and certain vitamins in the diet. (3) Action of toxic substances on the gland, such as those of some chemical poisons, toxins of intestinal and other bacteria and the goitrogenic products resulting from the fermentation of excretal materials and remnants of food. (4) Lack or insufficiency of certain food-essentials such as vitamins, hexuronic (or ascorbic) acid, iodine, phosphates and certain unidentified anti-goitrogenic substances associated with well-balanced food.

The stage of theory in regard to the ætiology of endemic goitre is now passed. There is no doubt a great deal more is to be known, but the proven facts should encourage the workers to proceed further ahead with the accumulation of fresh facts, so that, before long, the world may know a great deal more about the remoter mysteries which still surround the ætiology of the protein malady, which we call 'Goitre'.

The British Association—Leicester Meeting, 1933.

The Presidential Address—Some Chemical Aspects of Life.

SIR FREDERICK HOPKINS' thoughtful address relates to the chemical processes that determine the mechanism of life.

'Though speculations concerning the origin of life have given intellectual pleasure to many, all that we know about it is that we know nothing.' We do, however, know a few fundamental facts concerning that process. One such is the arrest of the steady increase of entropy displayed by all the rest of the Universe. That the living organism checks the degradation of energy in Nature is primarily a biological concept. Related to it and of equal importance is the concept of organisation.

'It is almost impossible to avoid thinking and talking of life in this abstract way, but we perceive it, of course, only as manifested in organised material systems, and it is in them we must seek the mechanisms which arrest the fall of energy. Evolution has established division of labour here. From far back the wonderfully efficient functioning of structures containing chlorophyll has, as everyone knows, provided the trap which arrests and transforms radiant energy fated otherwise to degrade—and so provides power for nearly the whole living world. It is impossible to believe, however, that such a complex mechanism was associated with life's earliest stages. Existing organisms illustrate what was perhaps an earlier method. The so-called autotrophic bacteria obtain energy for growth by the catalysed oxidation of materials belonging wholly to the inorganic world; such as sulphur, iron or ammonia, and even free hydrogen. These organisms dispense with solar energy, but they have lost in the evolutionary race because their method lacks economy. Other existing organisms, certain purple bacteria, seem to have taken a step towards greater economy, without reaching that of the green cell. They dispense with free oxygen and yet obtain energy from the inorganic world. They control a process in which carbon dioxide is reduced and hydrogen sulphide simultaneously oxidised. The molecules of the former are activated by solar energy which their pigmentary equipment enables these organisms to arrest.'

'Are we to believe that life still exists in association with systems that are much more simply organised than any bacterial cell? The very minute filter-passing viruses which, owing to their causal relations with disease, are now the subject of intense study, awaken deep curiosity with respect to this question. We cannot yet claim to know whether or not they are living organisms. In some sense they grow and multiply, but, so far as we yet know with certainty, only when inhabitants of living cells. If they are nevertheless living, this would suggest that they have no independent power of obtaining energy and so cannot represent the earliest forms in which life appeared. At present, however, judgment on their biological significance must be suspended. The fullest understanding of all the methods by which energy may be acquired for life's processes is much to be desired.'

The past one hundred years have witnessed considerable amount of controversy between the extreme physico-chemical and the vitalistic concept of life. We are yet far from knowing the ultimate truth but it would form a useful basis for discussion if we recognise that 'at a different and recognisable level of its dynamic organisation, an organism can be logically described in physico-chemical terms alone.'

Researches conducted during the present century have brought about marked changes in our outlook in various directions. To take an instance one may cite the respiration of the muscle and the attendant transformations. To-day we know that the previous 'conception of continuous building up and break-down of the muscle substance, as a whole, has but a small element of truth. The colloidal muscle structure is, so to speak, an apparatus relatively stable even as a whole when metabolism is normal, and in essential parts very stable.' The related chemical processes and energy transformations have also been studied with remarkable thoroughness. They show, among other things, that the conditions are, to a large extent, similar to those occurring in the yeast cell, thus providing a striking illustration of the unity of life.

The living cell would be a static system were it not for the fact that it is equipped with a variety of enzymes which assist in bringing about the required transformations. Each enzyme is specific in its action. The combined activities of the different enzymes present in a cell determine its ultimate physiological behaviour and thus distinguish it from other forms of life.

When the multitude of chemical events in a living cell are well co-ordinated, then the latter displays its sensitiveness to molecules of the special nature which enter from without. A striking instance of this is provided by the response of the heart to the impulse of the vagus nerve. When the heart receives vagus impulses, the substance, acetyl choline, is liberated within that organ. It is acetyl choline that ultimately produces the characteristic effect as may be demonstrated by direct injection of graded doses of that chemical.

Similar and, perhaps, even more profound are the effects of the chemicals which are formed in specialised organs of the animal body and which maintain harmonious growth and control the rate of metabolism. Some of these chemicals such as adrenalin, thyroxin, secretin and insulin are already well known. More recently, considerable light has been thrown on the nature and mode of action of œstrin, the harmone which, in a most remarkable manner, co-ordinates the phenomena of sex.

In the group of substances which control and co-ordinate events in the animal body by virtue of specific molecular structure we must also include the vitamins. As distinct from the harmones which are formed in the animal body, the vitamins have to be supplied in the diet. The distinction between the two is not, however, so great as it may appear because some animals can synthesise the requisite vitamins, in which case the latter become harmones.

The recent output of scientific work in the field of vitamins is prodigious, nearly one thousand papers on the subject appearing in a single year. 'Some aspects of its development have been interesting enough. The familiar circumstance that attention was drawn to the existence of one vitamin (B1 so called) because populations in the East took to eating milled rice instead of the whole grain; the gradual growth of evidence links the physiological activities of another vitamin (D) with the influence of solar radiation on the body, and has shown that they are thus related, because rays of definite wave-length convert an inactive precursor into the active vitamin, alike when acting on foodstuffs or on the surface of the living body; the fact again that the recent isolation of vitamin C, and the accumulation of evidence for its nature started from the observation that the cortex of the adrenal gland displayed strongly reducing properties; or yet again the proof that a yellow pigment widely distributed among plants, while not the vitamin itself, can be converted within the body into vitamin A; these and other aspects of vitamin studies will stand out as interesting chapters in the story of scientific investigation.'

In recent years increasing evidence has also been obtained to show that many micro-organisms and higher plants require the supply of vitamin-like substances for the promotion of growth. The 'auxines', as they are called, are essentially of the nature of harmones.

Our knowledge of the molecular structure of vitamins and harmones is growing fast: the relation between the individuals and the manner of their action on animal tissue is also fast coming to light. As an instance of this, one may cite the following observations that relate to some well-known substances.—"The vitamin, which in current usage is labelled A, is essential for the general growth of an animal. Recent research has provided much information as to its chemical nature. Its molecule is built up of units which possess what is known to chemists as the isoprene structure. These are condensed in a long carbon chain which is attached to a ring structure of a specific kind. Such a constitution relates it to other biological compounds, in particular to certain vegetable pigments, one of which a carotene, so called, is the substance which I have mentioned as being convertible into the vitamin. For the display of an influence upon growth, however, the exact details of the vitamin's proper structure must be established. Now turning to vitamin D, of which the activity is more specialised, controlling as it does, the growth of bone in particular, we have learnt that the unit elements in its structure are again isoprene radicals: but instead of forming a long chain as in vitamin A, they are united into a system of condensed rings. Similar rings form the basal component of the molecules of sterols, substances which are normal constituents of nearly every living cell. It is one of these, inactive itself, which ultra-violet radiation converts into vitamin D. We know that, as stated, each of these vitamins stimulates growth in tissue cells. Next consider another case of growth stimulation, different because pathological in nature. As you are doubtless aware, it is well known that long contact with tar induces a cancerous growth of the skin. Very important researches have recently shown that particular constituents in the tar are alone concerned in producing this effect. It is being further demonstrated that the power to produce cancer is associated with a special type of molecular structure in these constituents. This structure, like that of the sterols, is one of the condensed rings, the essential difference being that (in chemical language) the sterol rings are hydrogenated, whereas those in the cancer-producing molecules are not. Hydrogenation indeed destroys the activity of the latter. Recall, however, the ovarian harmone œstrin. Now the molecular structure of œstrin has the essential ring structure of a sterol, but one of the constituent rings is not hydrogenated. In a sense therefore the chemical nature of œstrin links vitamin D with that of cancer-producing substances. Further, it is found that substances with pronounced cancer-producing powers may produce effects in the body like those of œstrin. It is difficult when faced with such relations not to wonder whether the metabolism of sterols which, when normal, can produce a substance stimulating physiological growth, may, in very special circumstances, be so perverted as to produce within living cells a substance stimulating pathological growth." Some of the links still require experimental support, but even the observations, so far made, are sufficiently conclusive to show that there is close relation between chemical structure and biological activity.

The relative importance of the physical sciences and biology in the study of the phenomena of life has been much debated, but it would suffice to say that, whatever be their limitations, the former are bound to profoundly affect biological conceptions. At the same time, it should be emphasised that pure biology, in all its concepts, has an important bearing on human welfare though, unfortunately, it has not lately been realised so well as it should be. This is partly due to the neglect of biology in our educational system and partly to the fact that physical sciences have, lately, had more brilliant exponents to the intelligent lay public than biology.

In recent years, much thought has been given to the possible misuse of the gifts of science to mankind. 'The command of nature has been put into man's hand before he knows how to command himself.' It should, at the same time, be admitted that the fault is with mankind and not with science. "War apart, the gifts of science and invention have done little to increase opportunities for the display of the more serious of man's irrational impulses. The worst they do perhaps is to give to clever and predatory souls that keep within the law, the whole world for their depredations, instead of a parish or a country as of yore."

There are two other great questions before mankind which require careful consideration. One is the paradox of poverty in the midst of plenty and the other, replacement of human labour by machinery. Applied science should take no blame for the former, but indeed claim credit unfairly lost. As for the latter, there would now appear to be greater fear arising from 'Money *versus* Man' rather than from 'Machinery *versus* Man'!

Considering the present march of events, there is great need to plan for the future. 'In such planning the trained scientific mind must

play its part. Its vision of the future may be very limited, but in respect of material progress and its probable consequences Science has at least better data for prophecy than other forms of knowledge.' 'Though statesmen may have wisdom adequate for the immediate and urgent problems with which it is their fate to deal, there should yet be a reservoir of synthesized and clarified knowledge on which they can draw. The technique which brings Governments in contact with scientific knowledge in particular, though greatly improved of late, is still imperfect. In any case the politician is perforce concerned with the present rather than the future.' 'When civilization is in danger and society in transition might there not be a House recruited from the best intellects in the country with functions similar (*mutatis mutandis*) to those of Bacon's fancy? A House devoid of politics, concerned rather with synthesising existing knowledge, with a sustained appraisement of the progress of knowledge, and continuous concern with its bearing upon social readjustments. It is not to be pictured as composed of scientific authorities alone. It would be rather an intellectual exchange where thought would go ahead of immediate problems!'

'If the political aspirations of the nations should grow sane, and the artificial economic problems of the world be solved, the combined and assured gifts of health, plenty, and leisure may prove to be the final justification of applied science. In a community advantaged by these each individual will be free to develop his own innate powers, and, becoming more of an individual, will be less moved by those herd instincts which are always the major danger to the world.'

Section A.—Mathematical and Physical Sciences.

THE Presidential Address to Section A of the Leicester Meeting of the British Association was delivered by Sir Gilbert T. Walker on Seasonal Weather and its prediction. After pointing out the importance of weather forecasts, he stressed the danger to the prestige of the science which might arise from over-confident forecasts based on insufficient data. He also deprecated the practice of ascribing periodicity to weather conditions on insecure evidence and trying to predict weather on the basis of such assumed periodicity. Passing next to his main theme, the lecturer explained what was meant by the correlation coefficient between two varying factors. The method of weather determination was then explained. Taking the variation over a period of years of the pressure, temperature and rainfall of a number of typical places whose variations show a positive or nagative correlation coefficient approaching unity a mean graph or set of numbers is computed and taken to be characteristic of the region. Then the correlation coefficients between this mean variation and the variation of the weather conditions at any particular place are calculated. Wherever there is a large correlation coefficient between the variations say in winter and those in summer, there is opened up the possibility of predicting summer conditions from the winter oscillation. Sir Gilbert illustrated this process by means of a number of graphs showing the North Pacific Oscillation and its relation to the pressure, temperature and rainfall in the surrounding regions, and also the Southern Oscillation from December to February and the same from June to August with the correlation between them. The lecturer also pointed out the necessity of a careful discrimination in drawing conclusions from statistics and illustrated his remarks by means of a very effective example, in which a comparison of illiteracy at marriage with unemployment led to a high negative correlation coefficient, but the fallacy lay in not taking into account the trend of the total amount of trade at the same time. Sir Gilbert then quoted instances from actual practice where the above methods had led to important results as in the monsoon forecasts in India and weather predictions in Southern Rhodesia. He then described the methods used for seasonal forecasting in Sweden and Russia and referred to the researches carried out by Dr. Franz Baur at Frankfurt a.M. In conclusion, the lecturer again stressed the necessity for stringent tests of any suggested periodicity in weather and for caution in prediction and expressed the hope that the subject may draw more investigators to its study on account of its interest and importance.

Section B.—Chemistry.

IN his Presidential Address to Section B (Chemistry) of the British Association, Prof. R. Robinson has made a fascinating and extremely valuable survey of his brilliant researches on the anthocyanin pigments of plants, which in the course of a decade have revolutionised our knowledge of the subject. A prefatory account of some natural colouring matters and their synthetic analogues indicates the value of investigations on plant pigments from the point of view both of academic interest and of technical possibilities.

The pioneering work of Willstatter established the main features of the structure of the anthocyanins as saccharides, occasionally acylated, of the anthocyanidins. They exhibit amphoteric character, forming salts with both acids and bases. The constitution of the three fundamental anthocyanidins, pelargonidin, cyanidin and delphinidin, has been proved beyond doubt by degradation and many syntheses. Although one method of synthesis, the reduction of quercetin to cyanidin, offers a ready and attractive hypothesis of the biogenesis of the anthocyanin pigments, the experimental support for such a view will not bear scrutiny.

Peonidin, petunidin, malvidin and hirsutidin have been shown to be methyl ethers of two of the three fundamental types and all have been synthesised.

The greater number of the anthocyanins can be classified as (*a*) 3-monoglucosides and 3-monogalactosides, (*b*) 3-rhamnoglucosides and other 3-pentoseglycosides, (*c*) 3-biosides, (*d*) 3 : 5-diglucosides, and (*e*) acylated anthocyanins. Several of the types, notably pelargonin, cyanin, peonin, malvin and hirsutin, have been synthesised by ingenious modifications of the general schemes of pyrylium salt synthesis devised by Robinson in collaboration with Pratt and others.

(Mrs.) Robinson and Robinson have studied the behaviour of the anthocyanins as indicators and the causes of the variations of flower colour. The main factors affecting flower colours are: (1) the nature and concentration of the anthocyanins

and other coloured substances present; (2) the state of aggregation of the anthocyanin in solution, the pH of the cell-sap and the presence of protective colloids being some of the subsidiary factors affecting this; and (3) the presence or absence of co-pigments and, problematically, the effect of traces of iron and other complex forming metals.

The culmination of the work so far is the evolution of qualitative tests, dependent for example on oxidation, on colour variation in solutions of graded pH, and on distribution between immiscible solvents, which enable us to recognise the nature of an anthocyanin with speed and certainty.

Section C.—Geology.

IN his Presidential Address to the Geology Section of the recent (Leicester 1933) Meeting of the British Association for the Advancement of Science, Prof. W. G. Fearnsides deals with an intensive study of the structures in the coal fields of the Midland Province in England. In accordance with his strong conviction that structural geology is a science of measurement and that the real geology of an area is not fully known until it can be represented by a model true to scale. Prof. Fearnsides has chosen the Midland coalfield province, with a view to prepare such a model, if possible, based on known details of the geology of this area compiled from the records of nearly a thousand working mines within this province. From a detailed account of the stratigraphy and mode of accumulation of the local rocks and of the crustal movements which allowed their accumulation in the Midland carboniferous geosyncline Prof. Fearnsides has proved that the Midland Province is a structural unit of deposition and slowly developed as a coal measure geosynclinal basin which was averted before Permian time; and in general, it is now a synclinorium with a central lop-sided crumpled dome. The synclinals within the synclinorium "deepened intermittently, but progressively, as the geosynclinal filled; and though as a whole the province may occupy an early downfold in the foreland of the Hercynian Alpine chain, its leading fold lines are re-emphasised and rejuvenated structures which in origin are older."

Section D.—Zoology.

DR. GRAY gives an indication of the scope of his address by formulating three questions which, though historical, have to be asked now and then in reviewing the progress of the different branches of Zoology. What is our conception of the essential nature of the living organism? Do we believe that the activity of living matter and its potentiality for change can be expressed adequately in terms of physical units? Do we incline to the belief that living animals have been evolved from inanimate matter? These questions in one form or another have perplexed the mind of philosophers of antiquity who sought refuge in revealed religion and within recent times several theories have been propounded in answer to them. Of these theories, the mechanistic and vitalistic concepts of life have held the ground with varying fortunes.

According to the Mechanical Theory of Life, the biological phenomena are only complicated constellations of physical and chemical processes. It is true that the results that have been obtained by the application of physical and chemical methods as instruments of biological investigations, have greatly helped the understanding of the physical and chemical attributes of living matter and the elucidation of certain aspects of single physiological process, but obviously they can offer no adequate explanation of the equally fundamental facts such as adaptation, regulation, activity, autonomy, compensation and pathology which give to the organisms a unique position in contrast to the inorganic world. The mechanical theory of life as Dr. Gray has pointed out, received a fresh impetus by the synthesis of certain organic compounds and by the parallelism instituted between the processes of organic and terrestrial evolution, as though they involved the operation of similar forces. Among the Biologists there are notable advocates of the mechanical theory of life and "it is a curious but pertinent fact that the most far-reaching mechanistic views have been and are being put forward by biologists, the more cautious views or the vitalistic views are held by physicists and chemists." It is conceivable that at some remote time in the geological history of the World inanimate matter may have possibly been transmuted into living substance just as it is perfectly conceivable that "it is also possible for a stone to leap spontaneously from the surface of the earth." "These things are possible but are they probable?" Biological researches do not provide any evidence to support the spontaneous origin of living substance and attempts on the part of biologists to postulate the spontaneous origin of intermediate stage between the living and the inanimate world cannot be comprehended under the category of "laws" which relate to the body of verifiable natural events. If we can entertain a concept of "co-ordinated series of self-regulating and self-propagating chemical reactions" in the production of living from inanimate matter, then what is it that hinders a not dissimilar concept being entertained of a lump of iron, wood, rubber and glass acquiring a co-ordinated series of self-regulating reactions to be spontaneously converted into a motor car, running through a crowded traffic without encountering accidents by generating a series of self-propagating reactions, including stoppages at kerb fountains for re-fuelling and re-oiling? What makes the mechanical view of life unacceptable to most scientists is the fact that it is unsuitable for the very purpose for which it was introduced, *viz.*, the physico-chemical analysis of vital processes, and so far as is known there is no evidence "which suggests that within the physical world, a dynamic machine has spontaneously come into existence." It is true that matter in a living organism in certain aspects of its behaviour may be interpreted in terms of physical and chemical units, but its characteristics in its wholeness are fundamentally different from those of inanimate objects. The modern theories of development and the researches of experimental embryology tend to confirm the view that "the cell has an individuality of its own—which is free from the limitations of statistical laws."

The main attributes of living organisms are more vividly recognised by studies in embryology than those of general biology, *viz.*, Life is a system-property and an organism functions in its wholeness. Mechanism provides us with no understanding of these fundamental characteristics of

the organisation of organic processes among one another, of organic wholeness, of the problem of the origin of organic Teleology or of the historical character of organisms. Since the fundamental attribute of living organisms is their complicated organisation and their wholeness, the experimental investigations of the single part and single process based on the methods of physico-chemical analysis, cannot provide a complete and satisfactory explanation of the vital phenomena. This mode of investigation gives little information concerning co-ordination of parts and processes in the living organisms in their wholeness which cannot be compared with the reactions observed in test tubes.

The physiologist and the experimental embryologist have added considerably to our knowledge of the physical and chemical behaviour of parts of living substance or organisms, but our knowledge of the organs and organisms is something more in that they arise from a system unlike their own and possess potentiality of evolving into newer and more complicated forms. The investigations of the physical and chemical properties of parts of the living organisms may give us an explanation of the attributes and behaviour of the mechanical framework of such parts under induced conditions but that explanation must be hopelessly inadequate to give us a complete picture of "the intrinsic potentialities of living matter revealing as it does a co-ordination of events" for which there is no parallel in inanimate nature. In the first type of study we are free to use the instruments provided by the physical sciences, but in regard to the latter, organismic biology must build on her own foundations and not tend to merge in physics or chemistry.

Section E.—Geography.

IT is immaterial whether Geography is a synthetic new recruit to the ranks of science or is the mother of all sciences; its cultural value in any scheme of education is always profound and the presidential address of Lord Meston is a skilful and elaborate exposition of this theme. The intrinsic usefulness of the study of Geography from a broader standpoint becomes all the greater when it establishes contact with the other branches of knowledge closely related to it and in fact we are fast arriving at a stage when knowledge cannot be treated in isolated segments, but should be presented in its wholeness. Perhaps instead of subjects, topics will have to be adopted for study and the children are to be enabled through easy and gradual stages, to grasp the many aspects from which each topic can be viewed and understood and that all approaches to the study of a topic result in unfolding one and indivisible truth. If at the present moment, the subject-method is in the widest practice in the class rooms, it is because the teachers do not have that intimate and comprehensive acquaintance with different branches of science so as to enable them to deal with the general scientific topics from their different viewpoints and harmonise knowledge into an integral unity.

The greatest mistake that the old text-books of Geography made was to describe the solid earth as an immutable structure, the hills as everlasting, the races of mankind as static social groups and the soils, climate, commerce, and international relations treated more or less from a stereotyped standpoint. If Geography is a function of a number of sciences, it must keep pace with the progress of the latter and its content must include the fresh data contributed by Physics, Chemistry, Geology, Biology, Sociology, Economics, Archæology, Anthropology, Explorations, Politics and History. Pre-historic geography is not a mere study of the movements of land and sea, the distribution of ice on earth's surface and the occurrence of strange fauna and flora, but represents precisely the point of time when the study of geography acquires a vastly human interest. It was about the close of the Tertiary period, that the movement of man, from whatever place he might have taken his origin, began and the direction of his march was determined by land connections, the climatic conditions, the abundance of food and the absence of enemies. Everything about this pre-historic man, his dress, his implements, his crude craftsmanship, his food and his rugged appearance, his habitation and his hunting trophies have far more interest to us than the startling disclosures of a modern political intrigue or the romance of modern social life. How he incessantly battled with the forces of nature and used his intelligence in laying the foundation of modern industries and culture must at all times exercise a strange fascination upon reflective minds and possess an irresistible attraction for the imagination of the young.

Geography is the study of the changes not only of those occurring in the crust of the earth and the borders of the ocean, but primarily of the transformations taking place in everything belonging to man and his environmental relations. The study of the globe in its physical aspects, the height of mountain ranges, the length of rivers, the size of lakes and the depths of seas must be barren and the interest and cultural value of Geography must be derived from the age and area of plants and animals and the biological lessons which they reveal, the produce of the land and sea and the uses to which the modern industries put them, the means of intercommunication which have built up political institutions, the distribution of the different races of mankind and their isolation determining their level of social development and how from cruder and simpler types of family system, the enormously complex international life has arisen. These must be the legitimate province of historical, political or human geography and the influence of its study must always exercise a profound influence on the growth of human mind and its outlook. With the expansion and growth of political institutions the geographical frontiers have shifted and within recent years, the map of Europe has been altered out of recognition. These shiftings of frontiers are an expression of the drama of the struggle for life ceaselessly enacted in nature and repeated by man and the cause in both cases is identical. Over-population, shortage of food, desire of colonisation, and armed position are the causes which lead to expansion or restriction of political areas, and when the inhibition becomes too strong, the restlessness of the nations manifests itself in ethnographical or racial movements, eschewing foreign admixtures. All this is biological phenomenon and intensely geographical in interest in its historical aspects.

Pre-historic geography is mystic and romantic; physical geography dealing with climate, the sea and the changes on the land's surface and its productivity, is a study of the grim forces of nature; historical or political geography is the story of the evolution of social and economic institutions and human geography provides the absorbing background for all these divisions, by making man the centre towards which every other aspect of geography converges. The study of man is one of actions and reactions; it investigates the conditions which lead to over-population and distribution and the influence on them of the geographical features of the country inhabited by him and his capacity to adapt himself to the changing environment, his struggles and his survival value. In these struggles, with the powers of nature, his character and personality unfold themselves, and how the physical features of a country have moulded the national characteristics and its historical destiny is part of the evolutionary aspects of geography which must excite imagination and cultivate understanding. The study of physical features of countries such as India and Greece must offer scope for the investigation into the rôle while geography plays in developing religious and moral ideas of the people. The profusion with which nature supplied the wants of man without demanding labour for procuring them, supplied him with opulence and leisure leading to contemplation of the stupendous natural phenomena by which he is surrounded and out of such meditations which could not search the fundamental causes all theistic forms of religion and the primitive forms of nature worship rose. Geographical conditions of Arabia and Palestine must certainly have influenced the development of Judaism and Islam, whose stern simplicity and unitarianism are the products of the desert solitude and the temper of mind it fostered.

Geography, as Lord Meston conceives it, helps us to understand where the defect in the eternal struggle with nature has been final and where victory can be snatched and how harmony with nature can be established. The conflict is not all with the blind forces of nature, but it has to be waged between ethnic groups for racial domination and the results to which such conflicts lead are well known. Viewed from such broad standpoints the materials of geography form the subject-matter of other more specialised branches of knowledge and the cultural value of their study must be as wise and deep as human civilisation itself.

Section F.—Economic Science and Statistics.

PROFESSOR J. H. JONES, the President of the Section, in his address spoke on the value of the gold standard. The address is of immense value especially in view of the present state of affairs in the world. He spoke about the working of the gold standard before the war, then about the effect of the war upon the financial machinery and then gave an account of the post-war history of the gold standard. "If we ignore other metallic systems, the real issue lies between the gold standard rigorously interpreted and the maintenance of national currencies which are not linked together by being linked to gold or any other common measure." Abandoning of the gold standard achieved considerable popularity for a time; later experience is that currency disturbances lead only to increased difficulties. Gold standard is useful to countries to pursue a currency policy, to maintain a stable price level. A national system of currency is applicable only to a country which wishes to isolate itself from the rest of the world. It is inconsistent with a policy of internationalism in other branches of economic activity. The gold standard stands for internationalism in economic affairs. It is a condition for the free development of trade between countries. Post-war changes in the value of gold have been due not to the gold standard but to the failure of a number of countries to operate that standard. Restoration of the gold standard is necessary to the progress of the world. But it is not suggested that an immediate return to the gold standard is desirable, before certain preliminary conditions are restored, such as the price averages of different countries expressed in their respective currencies have reached those heights which may be considered satisfactory. But it may happen that political considerations will drive countries to take to gold standard before the necessary preliminaries have been properly considered. There is also the question of unequal distribution of gold. It is said that a return to gold standard is impossible so long as the world's supply of gold is concentrated in two countries. But this is not really an insuperable difficulty, for if we could restore these conditions which are essential for the maintenance of the gold standard it is not unlikely that a redistribution of gold according to apparent need would be accepted. It is, however, true that "the gold standard is a form of discipline which may itself help to restore some of those conditions that enable it to be operated with success."

Section G.—Engineering.

IN his Presidential Address at the Engineering Section, Mr. Richard W. Allen dwelt on the outstanding developments in Mechanical Engineering during the past few years. The improvements in time-saving and labour-saving devices have been so rapid that it often seems doubtful whether mankind can adapt itself to the rapidly changing conditions. The last fifty years saw the three most important contributions to mechanical science, namely, the steam turbine, the Diesel engine and the centrifugal pump. Electrical generation and transmission have also so rapidly increased that Lord Kelvin's statement, made as recently as 1895, that power stations of 100,000 H.P. under one roof would be possible in the future, has been more than justified because at the present day there are single units developing more than this power.

In the field of the steam turbine the great pioneering labours of Sir Charles Parsons laid the main foundations for the turbine design of to-day. From the uneconomical non-condensing turbine, the condensing type was conceived, thus increasing the efficiency to a very great extent. The geared turbine made it possible to be adopted to ship propulsion, to driving electric generators and to operating various kinds of mills, where its greater economy of space and steam consumption gave it advantages over the steam engine. The thermal

efficiency has also increased so rapidly that at present, a figure of 34 per cent is possible.

The development of the oil engine has not been less phenomenal. Although it is only 41 years since Rudolf Diesel took out his patent, the advantages of the Diesel engine for land and marine service have been fully recognised. Considerable developments in the method of fuel injection, in speed, and in power per unit weight have been achieved. The low initial cost, the limited space required for its installation, the ease of starting from cold and the low costs of operation and maintenance have all contributed to the great industrial exploitation of the Diesel engine.

The centrifugal pump is also largely a development of the last fifty years, although its principle was known long before. Osborne Reynold's patent in 1875, of the multistage turbine, centrifugal pump and the use of guide vanes, established a very wide field of application for this type of pump, even for the handling of materials like coal, sands, gravel and the like, besides liquids. The axial flow type is a recent development in this field. The tin industry of the Federated Malay States and the large floating and growing docks of to-day have largely been made possible only by the aid of this pump.

Similar phenomenal development in naval and military services, radio-communication, aviation and transport have taken place. The whole outlook has entirely changed due to the substitution of science and the scientific method for the "rule of thumb" procedure of the so-called "practical man" of the previous generations. The lay-out of plant, the housing of machinery, the transport question, the introduction of the planning department, the testing department and the works laboratory, are all due to the adoption of the scientific method of outlook. In achieving this end, all engineers owe a debt to the National Physical Laboratory, the British Standards Institution and to the technical press of the country.

The training of the future engineer, the craftsman and the apprentice are then dealt with at length.

Section H.—Anthropology.

TRADITION is the unwritten code handed down from generation to generation, influencing profoundly every department of human thought and activity. We have traditional methods of agriculture, craftsmanship, eating, dealing with property, marriage, rituals, and social relations and etiquette, superstitious faiths, games and sports and even narratives of semi-religious events and studies. The long-continued observance of certain rules and practices for regulating human affairs and institutions soon acquire the force of law and in primitive social groups, the younger members must become versed in the traditions of the society before they are permitted to the privileges of "citizenship" of the group. In the case of unregulated minds, tradition, whether rational or otherwise, exercises absolute sway and its influence on every aspect of human life in semi-savage societies amounts to religious sanction. Lord Raglan's address is devoted to the consideration of traditional narrative in its various forms such as "Myth, legend, epic poem, ballad, saga and fairy tale" and the contribution of each of these to history. The historical and fictitious aspects of traditional narrative must be an interesting field of anthropological investigation.

The essence of tradition is its oral transmission from age to age and its contents relate to the heroic exploits of mythical persons, the mystic practices of rituals and the observances of certain social rules or procedure in the practical affairs of life. It flourishes in illiterate and semi-civilised communities and lingers even in the highly cultivated societies. The contribution of traditional narrative to history cannot be trustworthy because the illiterate people are notoriously indifferent to facts and the genuine sources of history are well authenticated documents of events and careers of great men. Perhaps the reason why historical facts are capable of being transmitted with accuracy from generation to generation is that the events are contemporaneously recorded and they affect the fate and fortunes of countries and the recollections of these events must be far too vivid to undergo distortions from which traditional narratives are apt to suffer. For this reason historical facts rarely enter into tradition.

Do the illiterate people invent fables and fairy tales which are obviously intended to please and profit the community? Traditional narratives, according to Lord Raglan, are rules for the performance of rites or ritual dramas. The prosperity of the community depends upon the correct observance of these rules, which form the basis of traditional narrative and it is almost impossible for figments of imagination entering into such narratives because the rites or ritual dramas are enacted in the presence of all the members of the community. Primitive man is incapable of embellishing or distorting tradition and beyond being a repository of legends, sagas and poems, he is devoid of all faculties of imagination. The large number and variety of traditional narratives prevalent among peoples have been built up by the ritual practices and ritual drama.

Family and local traditions do not form part of historical facts and to a large extent may arise from confusion of tribal names or from gratification of parochial pride. The family tradition of Sir Hereward Wake which Lord Raglan quotes is an instance of such a confusion of names. It arises from a desire to connect pedigrees with an ancient name, however mythical, for the purpose of securing sufficient antiquity. Local traditions are false history started by the local Antiquaries and the traditional accounts of Henry V of England made famous in the historical plays of Shakespeare are opposed to historical facts of the early life of this sagacious monarch. Similarly, folk tales and songs and anecdotes have no foundation in history. Lord Raglan's theory is that the traditional narrative is always an account of a ritual drama and this view is based on the fact that in tribes and localities where traditional narratives abound, ritual dramas are numerous and elaborate. The principal ritual drama is the "creation rite", the installation of the king or the old king ceremonially killed by his successor. In all primitive social organisations, the ritual was practically universal, but the myth associated with the ceremonies and festivals partook of local character. If the myths and legends have their origin in the world of ritual drama, then the place of history in it becomes meaningless. In the process of evolution the ritual dramas undergo

transformations and among the numerous instances of such transformations, the cycle of Robinhood which forms the most important body of English and Scottish traditional narrative is a classic instance. May celebration was called "Robin Hood's Festival". He was a mythical hero whom the people were fond of personating in semi-dramatic performances and dances usual at that season. Lord Raglan concludes that all traditional narratives are accounts of ritual drama and gives a summary of their principal features. A narrative is generally dramatic, but history is seldom so. The action of the narrative is based on songs and rhymes and the language of the characters though coming from different countries is the same. Again in costume, conversation, conventional settings and in other important particulars, traditional narratives may be cast in quasi-historical language but cannot be true history. If in the early historical works, there are traces of traditional narratives as in the case of Herodotus and Thucydides, such references as for instance the historical character of the *Illiad*, are due to the methods of treatment which must be unscientific. The foundations of social anthropology have been encumbered "not merely by the ruins of ancient superstitions, but also by the jerry-buildings of pseudo-history and pseudo-psychology" with the consequence that the subject is not accorded a place among the sciences. "It will never occupy what should be its proper place until a vast quantity of pre-scientific and pseudo-scientific rubbish has been cleared from its path" and Lord Raglan's brilliant address ought to assist the clearance.

Section I.—Physiology.

PROFESSOR E. D. ADRIAN discussed the "Activity of the Nerve Cells".

The problem before us is whether it would be reasonable to discuss the working of the Nervous System with reference to its constituent cells. The Nervous System is responsible for the behaviour of the organism as a whole or, to use the classical phrase of Sherington, "its action is an integrative one". In the human we have not merely a Nervous System but also a mind. But we can discuss the activity of the nerve cells purely on the physiological plane. The Nervous System is composed of cells containing living protoplasm (which in itself offers any number of bewildering problems) but their more important function is to make the organism respond rapidly and effectively to changes in its environment and to achieve this they have developed a specialised structure and a complex arrangement in the body.

In the study of the development of the Nervous System emphasis was laid before on how the pattern of the Nervous cell is laid but now the approach is from why they are arranged in such a manner. In tissue culture and other variety of experiments it is possible to rearrange the geography of the Nervous System showing its plasticity—the forces moulding the system coming partly from the central mass of the nerve cells and partly from cells outside. The forces may be electrical or chemical, the nerve cells cling to structures already laid down, *e.g.*, the main arteries and the lymphs.

The Nervous System is made up of neuron cells with threadlike extensions. The activity is essentially rhythmic, probably a rapid breakdown and repair of the cells. The evidence comes from the analysis of minute electrical changes of cell activity sets as electrical Eddies. An external stimulus acting on a sense organ upsets delicate equilibrium of its surface the disturbance acting along the fibre while active process analogous to the spread of a flame along a fuse. The change is momentary excitement being followed by a rest and recovery. The impulses in a fibre may be as high as 300 or as low as 10. The sole function of the nerve fibre is to carry message without distortion. But these specialised reactions are not peculiar to the Nervous System and it may be observed that the ground plan of the mechanism is the same in the nerve cell or muscle cell.

The elaboration of our impulse is another problem, Sherington having worked on the Spinal Reflexes and Pawlow on the Brain. An important line of attack is by measuring electrical changes in the central grey-matter. It is found that there are large electrical oscillations in the cerebral cortex varying from moment to moment and difficult to experimental control. In the more measurable fibres of Optic retina it is found that there are waves in regular rhythm. It seems probable that both chemical and electrical changes may be concerned in spread of activity from one neuron to another. Our Nervous System is built up of cells with specialised structure and reactions—but the reactions are of a type to be found in many other cells. There are electrical gradients at an active point and it is a long step from the mechanical precision an impulse discharge to irregularities of the record from the cerebral cortex.

In considering the Nervous System as a whole clinical neurology has slightly emphasised exact localisation though this does not afford the whole explanation of cortical activity. Localisation as is now known is a matter of various than of single neurons. This is shown by an examination of habit formation and by remarkable way in which Nervous System adopts itself to injury. When the Central Nervous System is injured there is a greater evidence of localised function but that localised function is not a hard and fast rule. In reactions where there is no evidence of localisation, Lashby finds the important factor to be the total—mass of cortex.

How do the individual neurons combine to form a system capable of exactitude? This is as yet not possible for Physiology to explain but at distant date the solution may be found—not foreign to the conceptions of Physiology. The organisation of neurons into the Nervous System is yet a physiological problem and if a solution has to be found outside Physiology it will be interesting to know as to what light it throws on the relation of the Nervous System to the mind.

Section J.—Psychology.

IN delivering the Presidential Address of the British Association for the Advancement of Science at Leicester on the 8th of September 1933, Professor F. Aveling stressed the importance of mind over sensory experiences and made an emphatic plea for the status of psychology as an empirical science. All the sciences of Nature begin in sensory experience, abandoning the experience of conceptual construction and return to experience

to verify their constructive work. Empirical science is defined as the science which is supported by the evidence of the senses or which is built up out of the elements of experience. Physical sciences which begin and end in sensory phenomena are examples of the first and psychology an example of the second; but the ordinary use of the term 'empirical' limits experience to that of a sensory nature. This limitation is an arbitrary one and is due to a philosophical prejudice. There is no doubt that there is more in experience than in sensory elements. Empirical sciences which begin with sensory material, work from this towards its explanation on conceptual lines: and those sciences like Mathematics, which begin with abstract quantitative concepts work from these concepts and their relations towards a statement of the implications which are contained in them. Both these kinds of sciences are selective of their material and leave out of account much experience, which as such is as good as any other. "These neglected experiences are necessary to explain the constructions of the empirical sciences of Nature, for we need no longer concern ourselves with the deductive sciences .... It is psychology concerned with the totality of experience, objective and subjective alike, of which we are or may be conscious, and making no abstraction from the fact that it is experience, which provides an account of the empirical origin of principles of systematization and explanatory concepts alike which are found in the other sciences." On the other hand psychology is the most empirical of all sciences "in the sense that it deals directly with experience as such, makes no partial selection, but embraces all experiences alike indifferently and at their face value."

Section K.—Botany.

IN this exhaustive account of the types of Entrance mechanism of the traps of *Utricularia* (including *Polypompholyx*) the minute structure and behaviour of the valve and its contactual parts specially the threshold of seventy species of Bladderworts belonging to two major ecological groups are described. The trap is a snap-action mechanism—so swift is it that the whole action falls within the limit of 1/16 second. During this brief moment the side walls of the trap spring out, the door opens fully and closes half relaxed, when a column of water with small luckless animals rushes into the trap. The resetting of the trap takes place from 15 minutes to 2 hours or more during which period the water diffuses out of the trap and as a result of which the outer water presses equally on the walls and the door alike. The door is shifted out of its position, the water pressing thereon pushes the door in. Thus the trap is actuated. The water-tightness is maintained by a Velum which arises from the Epithelium of threshold. The structure of the door in all the species studied as correlated with the function of its various regions, remains uniform. Two general types of traps are noticed, *i.e.*, those that have broad threshold and those with narrow threshold. The characteristic glandular trichomes and their distribution in the trap has been observed. The details of several types are appended such as *U. cornuta*, *U. capensis*, *U. Cœrulea*, *U. monanthos*, *Polypompholyx*, *U. globulariæfolia*, *U. orbiculata*, *U. vulgaris*, *U. reniformis* and *U. purpurea*. In all these, living forms from the old as well as the new world have been studied.

Section L.—Education.

THE Presidential Address of Mr. Holland to the Educational Section is a brilliant review of the principal educational developments rendered possible by the passing of several Education Acts commencing from Forster's Act of 1870 to Fisher's Act of 1918. These Acts deal with the elementary and secondary educational systems, their administrative control, the governing bodies and the distribution of grants, and on the whole the energy and zeal displayed by the County Councils and the County Borough Councils which were charged with responsibility for all forms of Education in their areas, deserve ample recognition by state for the excellent use they have made of the opportunities. The development of a sound national system of Education in a democratic country with conflicting public and private interests must be comparatively more difficult than its organisation in states with a unitary national purpose. In Russia which is dominated by a single idea, the whole aim of education is to train the young man to become a worker for consolidating a socialistic state. Under the Nazi administration Germany is giving up her liberal notions of free individual development. The child is part of corporative state and has no existence apart from it. The idea of education is service and subservience to the state. In Italy the teacher and pupil own allegiance to Fascism and education has no ideal higher than the glorification and advancement of Fascist movement and all other considerations are subordinated to the exigencies of the State. Concentration on a single aim such as the central European countries have placed before themselves will undoubtedly simplify and speed up the educational reform, but in countries where the demands of the public are neither simple nor uniform, the task of building up a homogeneous system is fraught with complexities and difficulties. We cannot organise a department of national Education which will reconcile the conflicting demands of the parents, of the Society, of the industrial organisations and of the State and these demands change frequently in proportion to the changes in the economic and political system of the people. In adjusting the system of education to the requirements of these very often conflicting interests, it should not lose sight of the important task of providing an atmosphere for the free and ample development of the personality and character of the child. In a free country untrammelled by any political or socialistic incubus, the primary duty of the state is to offer extensive opportunities for the children and young persons to benefit to the fullest bent of their natural aptitudes, from any system of education by which they are capable of profiting. It is this assertion of the individual rights which is at once the strong and weak point of the British system of Education and it is this feature which baffles the efforts of would-be reformers of Education in England who wish to reconstruct a system on the socialistic basis of the state.

The secondary education in almost every country has reached a stage of development when

further reforms are possible only by reorientation of the entire outlook and purpose of this grade of instruction. With the awakening of mass consciousness to the benefits of education and the increasing opportunities it offers for the betterment of the social and economic position of the communities, the secondary schools have ceased to be exclusive institutions of a class. They have turned numbers of young men of practical ability toward professional and clerical occupations, a diversion causing no small amount of uneasiness to industrial and commercial concerns. Any system of secondary education which does not set out to discover their natural talents to boys and girls, but creates a thirst for soft sinecure posts in State Services, is wasteful and the country loses the benefits which might otherwise accrue, by the employment of the creative faculties of the young people. Boys and girls who now prefer the labours of the desk might possibly be diverted to industrial occupation through the new type of service schools which are rapidly coming into existence; the success of these schools must depend upon the public support accorded to them in a measure so unreservedly extended to the secondary schools.

The relation of education to industrial and commercial organizations is discussed in great detail in the address and the reasons why secondary education has become a part time and post employment one are set forth. The success of all endeavours in educating the employees must ultimately depend upon a co-ordinated plan in which the responsibility is equally shared by the employers and the local authorities. Technical education in other European countries has tended to divide society into horizontal sections offering no stimulus for personal advancement and individual self-expression and technical schools with such ideals will never succeed in discovering the exceptional man upon whose energy and genius, all industrial expansion must depend. In the concluding portion of the address the problem of unemployment of young men and women whose numbers are increasing is dealt with. Fundamentally it is a problem for the solution of which the state must assume responsibility and we do not agree with Mr. Holland who points out that it is a subject for the local education authorities to tackle. The suggestion that the young people should be advised to remain at school till proper situations are found for them is no solution and the maintenance of pupils in the school beyond the necessary period must be viewed by parents with alarm and by the Government not as a helpful suggestion, for in both cases the money spent on educating the young men after the completion of the courses must be wasteful expenditure. Mr. Holland makes other suggestions such as the age of compulsory insurance being lowered to fourteen years, and credit being given against the unemployment fund for attendance beyond that age, and grants being obtained by local education authorities, from the Board by submitting area schemes of Fisher's Act of 1918. Admittedly all these are only palliatives and are not real solutions and social consciousness should be thoroughly roused to the demoralising effect of enforced idleness of a large section of able-bodied citizens on the efficiency and productive-power of the nation, before the major part of the question may be deemed as having been solved.

Section M.—Agriculture.

DR. ALEXANDER LAUDER'S address is a review of the contributions of chemistry to agriculture since the year 1880 when Sir Henry Gilbert addressed the Association on a similar subject.

The past fifty years have witnessed several discoveries of fundamental importance, among which particular mention should be made of the fixation of atmospheric nitrogen, the rôle of vitamins in animal nutrition, the theory of base-exchange in soils and the principles of bacteriology. Some of these have found application in practical agriculture while the others have greatly improved our knowledge of soils, fertilisers, crops and animal nutrition. Our organisation for demonstration and advice are also more efficient, so that it is now possible for us to assist the farmers more effectively than at any earlier period.

The soil has been studied from both academic and practical points of view. Extended surveys have been conducted and vast areas have been carefully mapped. Several new methods for determining the availability of plant nutrients have been devised and although none of them has proved fully satisfactory, yet the estimates obtained by them are more reliable than those by any of the earlier methods.

In the field of fertilisers, synthetic production of ammonium salts and nitrates, the discovery of the fertilising value of basic slag and improved methods of manufacturing superphosphate, deserve special mention. Attention should also be drawn to the new synthetic concentrates containing varying proportions of nitrogen, potassium and phosphorus.

Biochemical researches have, in no small measure, contributed to the advancement of our knowledge of plant and animal nutrition. The application of X-Rays to the study of plant tissues, the discovery of the chemical nature and mechanism of function of chlorophyll, increasing knowledge of the rôle of enzymes and investigations on the nature, behaviour and more recently, concentration and synthesis of vitamins are only a few of the outstanding contributions of the period.

In recent years, the opening of a number of research stations, establishment of bureaux of information for disseminating fresh knowledge, development of improved methods of packing, transhipment and marketing different products have also proved to be of great service to both farmers and dealers in agricultural produce.

Much more yet remains to be done. Particular mention should be made of the need for improved systems of cropping, so that crops of high nutritive value may displace those of inferior quality. Lands of poor yielding capacity should be improved so as to maintain more cattle, sheep and poultry than at present. The possibilities of further reclamation of land should also be investigated.

Dr. Lauder's address is a useful compilation but it is unfortunately lacking in freshness of outlook. Discussion of a few of the most outstanding problems in agricultural chemistry together with some suggestions regarding new lines of attack would have greatly enhanced the intrinsic value of the address.

Research Notes.

Biological Observations on Ophiurids.

I.

IN a recent paper forming one of the series entitled "Papers from Dr. Th. Mortensen's Pacific Expedition, 1914-16" (LX) (*Vidensk. Medd. fra. Dansk. Naturh. Foren.*, **93**, pp. 1-8, pl. 1, 1932), Dr. Th. Mortensen gives a very interesting account of the unusual features of the Ophiurid, *Ophiocanops fugiens* Koehler, 1922, which had been imperfectly described. This species lives in moderate depths in the Philippine Seas and adjacent waters. The chief features of this extra-ordinary Ophiurid are: (1) the extremely small-size of the disc, (2) the absence of ventral interradii and bursæ, and of the mouth-shields except the madreporite which is as large as an adoral plate, (3) the uppermost of the arm-spines, which is also the longest, is upwardly directed in the skin of the dorsal side of each arm forming a series of chambers extending to nearly three-fourths of its length, (4) there is usually a pair of gonads to each joint opening separately on the side of the arm, and (5) the small stomach of the disc has radiating branches extending into the space above the genital organs in each arm, and thus providing an ample absorbing surface. The vertebræ and the articulation are a slight modification of the streptospondylous type found in the Euryalids, but the extraordinary arrangement of the arm-spines, the gonads, and the stomach is unique in Ophiurids and does not entitle the species to a place amongst the Euryalids or Ophiomyxids. Dr. Mortensen has, therefore, erected a separate family *Ophiocanopidæ* n. fam. to receive this species.

In the same paper (p. 21) Dr. Mortensen records the occurrence of an albino *Ophiocoma scolopendrina* (Lemarck) from Port Louis, Mauritius. The colour of the species is usually dark, mottled with white, but in the specimens that the author observed the black ground colour was entirely absent except at the tip of two of the arms.

H. S. R.

II.

IN another paper (LXIII) of the same series (*Vidensk. Medd. fra. Dansk. Naturh. Foren.*, **93**, pp. 171–194, 1933) Dr. Th. Mortensen has recorded some interesting biological observations on Ophiurids collected in the Indo-Pacific region which are summarised below:

1. The author describes an extraordinary little epizoic ophiurid, *Nannophiura lagani* gen. et sp. nov. found living amongst the spines of the oral side of *Laganum depressum*. It is the smallest of ophiurids hitherto known, with the disc not more than 0·5 mm. in diameter. It has 5 equally developed arms 3 mm. long, the distal part of which is broad and flattened with the spines partly modified into hooks, and in life has been observed to cling oral side away from its host to the spines by its prehensile arms which roll up towards the aboral side. The disc is made up of one central, 5 radial, and 5 small marginal plates. Ventral interradii and genital slits are absent. The ventral and dorsal arm plates are well developed, and there are no tentacle scales beyond the first. The mouth papillæ are rudimentary. The radial nerves are exceedingly well developed in correlation with the prehensile apparatus. This little ophiurid is by no means a parasite as it clings oral side away from the surface of the host, but it apparently finds a safe abode amongst the spines of its host which carries it about on detritus at the bottom of the sea. The detritus whirled up by the ciliary currents produced by the skin of the test and the spines of the host probably forms its main article of food.

2. The practice of autotomy as a means of propagation is well known in the Ophiuroidea and other groups of animals but in the family Amphiuridæ this phenomenon appears to have been overlooked with the result that there are very few records of it in literature. The author describes a new species, *Amphiodia dividua* from a lagoon at Cannoniers Point, Mauritius, which reproduces by autotomy. The chief features of this species are that the disc has no primary plates, but is covered on both sides by small, thin, simply perforated scales of one size, that the radial shields are elongate, very narrow and contiguous along their whole length, which is nearly half that of the radius of the disc, and that each radial shield has a prominence at its outer end which carries two or three hyaline spines. The habitat of the species is peculiar, and harbours Synaptids, Euteropneusts, Planarians, Nemerteans, Annelids and two other species of viviparous ophiurids. The lagoon dries up at low tide leaving a thick mass of

much-tangled filamentous green algæ which retains some water, and the author suggests that the habitat of these ophiurids has some connection with their mode of propagation.

3. In the large sandy flats exposed at low tide at Polana Beach on the coasts of Dolagoa Bay, Portuguese East Africa, the author found among many interesting animals some small ophiurids on the oral side of *Echinodiscus disperforatus* Leske which usually lies concealed under sand. These ophiurids are described under the name *Amphilycus androphorus* gen. et sp. nov. The chief point of interest in this form is the occurrence of a male individual on the oral side of the disc with its arms alternating with those of the adult female in such a way that the mouths of the two sexes are opposed to each other. The males are very small, with their disc not exceeding 1 mm. in diameter, while the females have a disc with a diameter of 5 mm. The author regards this phenomenon as an extraordinary case of copulation hitherto unknown in ophiurids which differs from the only other known instance of "copulation among Echinoderms, that of *Archaster*, in being not temporary as in the said sea-star, but constant—a continuous erotic embrace, the female, evidently, carrying its male throughout life." The instances of viviparity in *Ophiodaphne materna* and *Ophiosphœra insignis* recorded by Koehler in his Memoir on the Ophiurids of Australian and Malayan Seas are, according to the author, really a case of sexual dimorphism in which each female is accompanied by its much smaller sexual mate on the oral side of the disc.

4. In this note the author, discussing the occurrence of viviparity in ophiurids, adds four more instances of this phenomenon to those already known, and describes a new species of *Ophionereis*, *Ophionereis vivipara* from Cannoniers Point, Mauritius. He gives a list of the known viviparous ophiurids with remarks on the condition of the sexual glands, hermaphrodite or sexes separate, from which it is clear that the majority of viviparous species are hermaphroditic. The casual relationship of viviparity and hermaphroditism is unknown, and the author leaves the problem open with the remark that hermaphroditism is in some way connected with viviparity, and has been acquired gradually among the more specialised forms.

H. S. R.

Floral Anatomy and Its Morphological Interpretation.

IN a recent paper on the subject (*New Phyt.*, Aug. 1933), Agnes Arber shows that the differences between the flower and the vegetative shoot are conditioned in the main by three factors: (1) The divergence of the floral members from the foliage leaf type in correlation with the difference between sporogenous and vegetative activity. In the carpel this involves the shifting of activity from the midrib to the margins. (2) The peculiar relation of the ultimate leaf members (carpels) to the apex of a shoot of limited growth (the floral axis). (3) The telescoping of the floral axis, and its intimate association with the parent axis and bract, which leads to close packing of the appendages, and favours cohesion, adhesion, and various forms of distortion, suppression, and departures from radial symmetry. With this theory of the flower as a basis, she considers the phylogenetic claims of floral anatomy. She holds that the general scheme of vascular system may have some value as indicating the broader trends of race history, but from a study of certain rudimentary leaves, sepals and stamens, it appears to her that there is no positive evidence for the alleged 'conservatism' of vascular bundles or for their survival when the organ which they supplied has ceased to exist.

Mucus Formation in Goblet Cells.

MR. E. S. DUTHIE in an article on the "Mucus formation in Goblet Cells" (*P.R.S.B.*, 784, 1933) starts with a brief review of the previous work done by Nassonov, Clara and more recently by Florey. Vital stains and also the classic technique have been employed and the subjects of the experiment were young and adult mice. The secretory granules make their appearance at the periphery of the cells where the mitochondria abound. Having thus made their appearance possibly due to the influence of the mitochondria they migrate into the Golgi region where the transformation into the mature mucin granules takes place and this is stainable.

Plant Galls as Natural Checks to Wild Vegetation.

OUR knowledge of the rôle of plant galls in the economy of Nature is very

fragmentary. Since 1928 the writer has been interested in this highly fascinating aspect of cecidology. A preliminary study in the South Indian region has yielded certain extremely interesting results, which it was thought worth while to record here.

One of the important parts played by plant galls in Nature is that of natural checks to the abnormal spread of wild vegetation. Many species of galls effectively keep wild plants within certain normal bounds. But for the formation of these galls, which reduce their numbers, the plants now bearing them would spread over much larger areas of any locality. They would grow and spread so luxuriantly as sometimes to choke out of existence all other plants, which might happen to be cultivated and economically useful to man. Without such galls to our aid our constant fight against many noxious and troublesome weeds would be far tougher than now and we should have many more weeds on cultivated land. The extremely troublesome weed *Lantana* would be a more formidable enemy to the agriculturist than even now, but the formation of the fruit galls on *Lantana* by a gall-midge *Asphondylia lantanæ* Felt. reduces the number of seeds produced to 50% to 60%. This in turn aids to keep the species within reasonable limits. South Indian jungles should be richer than now in *Morinda tinctoria* Roxb., if the latter does not bear the newly discovered flower galls by *Asphondylia morindæ* N. sp. This midge produces galls on the flowers of 80% of the plants and only a much smaller portion of the rest develop into ripe seeds. *Mimusops hexandra* Roxb. would form denser societies in the South Indian scrub-jungles but over 95% of its flowers turn into a curious, undescribed gall. In a certain scrub-jungle in South India, due to an exceptionally moist and favourable condition in 1931, the wild twiner *Rivea hypocrateriformis* Choisy. spread and produced an unusually larger number of flowers. It was estimated that the flower production in the previous two years was 50% less than in 1931. This increase in flowers in 1931, however, did not bring about in 1932 any unusual increase in the number of plants in the locality or in the neighbourhood. This was due to the fact that in 1931 and 1932 gall-formation on the flowers by an undescribed Itonidid (*Cecedomyid*) was nearly 35% more prevalent than usual. The galls prevented the seed formation and hence kept down the number of plants.

All species of galls do not behave equally in this respect. Those species which involve in their development flowers, fruits, buds and roots are the most effective checks. Flower and fruit galls especially keep down the plants incapable of vegetative modes of reproduction. Sporadic forms of galls do not so effectively play this rôle as the epidemic ones. Due to the formation of galls on them, the flowers fail to reach maturity and seeds, which are needed for propagation, are not formed. This very seriously affects the spreading of the plant in the absence of a vegetative mode of reproduction. In any locality with a hundred or so of plants so affected only a few flowers develop normally and contribute to the spreading of the species. The species is thus checked. This, for instance, is the case with *Lantana* sp., *Mimusops hexandra* Roxb. and *Rivea hypocrateriformis* Choisy. Even when the plants with flower galls are capable of vegetative modes of reproduction their number is very much reduced. Gall-formation on roots so weakens the plants by under-nourishment that the production of an over abundance of flowers is very seriously affected.

There are a number of other instances in which galls play this part to a much larger extent than any cited here. Indeed the whole subject is very intricate but its full importance is not generally known. The present note merely aims at showing the extremely interesting field available for work. A detailed account of the subject is put off for a future occasion pending a more thorough investigation.

M. S. MANI.

The Investigation of Atmospheric Pollution.

THE Report of the observations made during the year ended 31st March 1932, which has been issued by the Department of Industrial and Scientific Research and published by H. M. Stationery Office, London (1933, Price 5*s.* net), makes very useful reading.

During the year under review, thirty-seven bodies—municipal, industrial or agricultural—co-operated in conducting the investigation. A number of useful observations were made, but the following deserve special mention. In view of the difficulties in obtaining accurate estimates of solid contents of smokes, attempts are now being made to devise a photo-electric apparatus for the purpose. Improved methods for the

estimation of sulphur impurities in air have been developed. The deposit-gauge measurements relate only to the limited areas covered by the instruments, so that generalizations therefrom for all the surrounding areas would not be justified. The results of analyses of deposits collected at different centres show considerable variations. A study of the averages for the past few years would show that the sulphur content of London fog has greatly increased while at other centres it has shown perceptible decrease. Ashington High Market gave the highest figure for total solids, ash and tar. Burnley Town Hall was richest in carbonaceous matter and chlorine. Others, like those from some of the country parks, gave low figures under all the heads.

Although India is not so much subject to dense fogs as Great Britain is, yet her dust problem is very much more serious. In view of the fact that dust is the chief carrier of a number of diseases, it is hoped that the Government would soon take up the problem seriously and appoint a competent staff to conduct the investigation.

Calcutta Fish Depôt.

CALCUTTA Fish Supply Co. (Managing Agents, *Agencies Co.*, India, 7-1, Lindsay Street, Calcutta) have opened a fish stall No. 109-110, Municipal Market, Calcutta, for the sale, under European supervision, of foreign sea fish in fresh condition and country sea fish. The stall is daily open for business from 5 to 10 A.M. The supply for the daily requirements is drawn direct from the cold storage at Kidderpore. The following foreign fish are sold: Sockeye Salmon, Red Salmon, Haddock, Herrings, Kippers, Bloaters, Flounders, Halibut, Trout, Snappers, Soles, Smelts, Cod, White Fish, Shrimps and Lobsters. The country sea fish are Bhetki ("India Halibut"), Indian Haddock, Indian Salmon, Indian Mackerel, Hilsa and Pomfret. The prices in September ranged from annas 7 per pound for Hilsa to Rs. 1–4–0 per pound for Lobsters and Halibut.

The entire stock of the foreign fresh fish is imported from British Columbia (Canada). Before shipment, the fish is gutted, cleaned and subjected to rapid freezing by Ottisen Process. There are only two boats that have arrangements to carry fresh fish, so the supply is received every two months. In 1932, the quantity of fresh fish imported was about one ton, but during the current year it is expected that import will be about 6 to 7 tons. The business is confined to Calcutta and the customers are mostly Europeans. At present it is a losing concern, but is said to be full of great possibilities, especially in the town of Calcutta, where practically the entire population consists of fish-eating people and where, due to a ring of middlemen, the fish is sold at a very high price and is almost beyond the reach of poor people. If this new venture can help to break the ring and lower the prices, it will be hailed as a great boon in Calcutta.

The establishment of this new company for the supply of fish in Calcutta brings home, very vividly, the immense possibilities of developing the fishery resources of India. Our seas and inland waters are full of fish. A Central Organisation is needed that will pay attention to the conservation of the resources, and will undertake vigorous application of fish culture methods. It will then be possible to maintain and build up in India the population of the finny tribes and to make the profession and business a profitable one. It is within living memory how Japan and British Columbia have developed their fishery resources by the well-conceived application of scientific methods. "Where no regulations exist as to the method in which fisheries should be worked, and should other circumstances be equal, that country or District which is most populated by man will be the denuded of fish. Individuals would sooner live by fishing than by agriculture, as the trouble of capturing the finny tribes is less than tilling the soil, being simply catching without any idea of preservation." Those, who have studied the methods of fishing in the various parts of India, know how true all this is with regard to the fisheries in India and how imperative it is to devise some means of conservation and propagation.

Science News.

Mr. P. K. Bose, Department of Botany, University of Calcutta, has, in an article appearing in the August number of *Modern Review*, made a critical survey of the problem of Water Hyacinth—the Terror of Bengal Water Ways. As in the case of the lantana and several other pests a plant which was introduced for ornamental purposes for the sake of its beautiful flowers has now become a menace to the cultivation of economical crops such as paddy and a menace to commerce through its paralysing the water ways. The credit of introducing it into Eastern Bengal goes to Mr. George Morgan, a resident of Narayangunj, and the plant is often humorously called Morgan's folly. The plant bears extremely pretty mauve or pale lilac flowers and the main mode of propagation is vegetative, the bladder-like leaf stalks acting like buoys and keep the plants floating. The plant is thus enabled to grow in deep as well as in shallow waters and being a native of tropical and subtropical South America has found Indian climate extremely suitable. By its abundance of leaves, dense vegetation and innumerable rootlets, it impedes flow of water, and has displaced many aquatic grasses which were so characteristic of Bengal paddy fields and so useful as fodder for cattle. It has overrun cultivated paddy fields to an alarming extent and has threatened jute cultivation. Tanks which supply drinking water have been covered by dense mass of water-hyacinth thereby rendering clean potable water scarce and by causing water stagnation in ditches, and shallow waters provide suitable breeding places for mosquitoes and other disease-carrying insects.

Attempts at economic utilisation of the plant have proved abortive. The fresh leaves have been used to some extent as cattle fodder and this has resulted in the deterioration of the quality of milk and a run down in the general health of the cattle. Trials were made to get potash on a large scale, but the process was too expensive and would not pay. The inferior quality of pulp obtainable from the plant renders its exploitation for paper manufacture impracticable. Attempts were made to prepare writing ink from the flowers but the colour did not appear to be fast, and the project was abandoned. The green plant contains about 95 per cent. water and it is highly doubtful whether any useful product can be obtained from the dry residue. Composting the weed for producing manure could be attempted but so far no organised effort appears to have been made.

The extermination of this weed has to be undertaken on a mass scale. Researches into Biological methods of extermination have to be carried out. Common salt and sulphuric acid have been found to be effective in killing the plant but the application over any extended area offers immense difficulties. Mechanical dredging and lifting operations could be carried out with some benefit. Simultaneous action should be taken in Assam, Bihar and Orissa and United Provinces to eradicate the plant as it is really astonishing how one single plant producing numerous offshoots which break away from the parent and grow independently, can be the cause of infecting large expanse of water.

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The Ninth Annual Report of the Geological, Mining and Metallurgical Society of India has reached us, as also a copy of the Presidential Address of Mr. K. Dutt, delivered at the Annual Meeting held at Calcutta on the 11th August. The Society records normal activities during the year 1932-33. Nine ordinary meetings were held at which 13 papers were read and discussed. Six issues of the Journal of the Society were published, comprising 22 original contributions, two of which refer to problems on Mining.

Mr. P. Sampat Iyengar, M.A., Director of Geology, Mysore Government (Retd.) was elected President for the year 1933-34. The other office-bearers and members for the Session 1933-34 are: Vice-Presidents: Dr. C. S. Fox, and Mr. M. M. Mukherjee; Joint Secretaries: Mr. N. N. Chatterjee and Dr. M. Chatterjee; Treasurer: Mr. S. L. Biswas; Librarian: Mr. B. N. Maitra; other Members of the Council: Prof. N. P. Gandhi, Dr. M. S. Krishnan, Mr. D. C. Nag, Mr. A. L. Ojha, Prof. S. K. Roy, Mr. Balaram Sen, Mr. K. K. Sen Gupta and Mr. D. N. Wadia.

In the course of the Presidential Address, Mr. K. Dutt dealt with the means and ways of putting on a sound basis the coal industry in India, which is the most potent factor in deciding a Nation's rôle in the field of manufacture. The problem of coal is closely linked with iron and although India is fortunate in possessing the necessary raw material, the Iron and Steel Industry is still in its infancy. The improvement of the metallurgical industries in India necessarily demands larger quantities of high class caking coal, and unless researches make it possible to use second class coal for caking purposes, a national calamity cannot be averted. The remedy for this lies in the manufacture of Petrol from coal which, thanks to intensive research in Germany and elsewhere, is now a practical possibility. In India a Fuel Research Board on the lines of the Imperial Council of Agricultural Research should be established forthwith to go into the question and investigate the possibilities of manufacturing petrol from coal.

The question of the soft coke industry also deserves consideration. Unless India produces soft coke of standard quality, suitable for fuel, by launching intensive research, the second class collieries will not be able to thrive. A permanent Fuel Research Board should be established immediately and the Government should be persuaded to take steps to utilize the surplus funds lying idle with the Coal Grading Board for maintaining the Research Board.

The lecturer suggested that the Society should try its best for establishing a research and statistical bureau with necessary financial aid from the Government and owners of metallurgical industries.

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In a communication entitled "The Filtrable Phase of the Tubercle Bacillus" (*Ind. Med. Gaz.*, **68**, 456, 1933) Dr. Soparkar has discussed the results of his experiments with suspensions of tuberculous sputum and tissues of animals in saline, filtered through Chamberland L_3 candles and inoculated subcutaneously into guinea-pigs. The passage of emulsions of lymph glands and spleens of previously inoculated animals, which were killed at regular intervals, revealed, on careful examination, acid-fast bacilli in 66 out

of 190 cases, the positive results being obtained with different stages of the passage. These acid-fast bacilli could be cultivated successfully, but the interesting fact observed was that the resulting strains differed culturally and in pathogenicity from the strains of bacilli present in the original material used for filtration. The conclusion, therefore, appears irresistible that there exists a filtrable phase of the tubercle bacillus when it can pass through a Chamberland candle, but a biological change is brought about so that the organism cultivated from the "filtrate" is *avirulent* for the animal and in some cases behaves like the avian bacillus.

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In a paper entitled " The Case for the Electrochemical Fixation of Atmospheric Nitrogen in India" (*Madras Agricultural Journal*, **21**, 1933) Viswanath has pointed out the urgent need for manufacturing in India nitrogenous fertilizers through the fixation of atmospheric nitrogen. With all the facilities available, it is indeed surprising that the problem has not been investigated on a scientific basis in India particularly as it is so essential for the development of agriculture and increased food-production. The question was examined by the Royal Commission on Agriculture (1926-27) who reported that the prospects of producing synthetic nitrogenous fertilizers were not encouraging. It should, however, be noted that the world's production of nitrogenous fixation products is still below demand. The Sugar Committee, who had also examined the question, expressed the opinion that the introduction of synthetic process for nitrogenous fertilizers was a matter of great importance. Further, a close examination of India's food position shows that for feeding her ever-growing population the available natural supplies are inadequate and the artificial utilization of atmospheric nitrogen is necessary. India produces at present food sufficient for the proper feeding of only two-thirds of her population. It is, therefore, clear that every effort must be made to increase our food supplies. Although recent work has established the importance of organic manure in the soil, both for quality and quantity of food crops, yet it would be necessary to augment our natural resources of organic manures by artificial fertilizers. There is no doubt that there is at least a case for the " immediate institution of nitrogen research laboratories in which chemists and electrical engineers should work in close collaboration and co-ordination and tell us definitely what the position is. "

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At a meeting of the British Medical Union, South Indian Branch, held at Madras on the 22nd September, Dr. C. Muthu delivered an interesting address on " Some Biochemical and Sociological Factors in Health and Disease". The lecturer pointed out that the close study of the life's processes in the light of modern biochemistry and psychology has shown that for normal health fresh air, sunlight and well-balanced food are essential, and the internal organs receive from these sources materials necessary for the elaboration of harmones, enzymes and other secretions. The man's environment and social condition also profoundly influence his health and disease. Almost all diseases can be traced to deficiency of some food factors, proteins,—which are primarily body builders, vitamins—which in minute quantities are essential to life and for the growth and development of the body, endocrine secretions, and mineral salts. It has been amply demonstrated in recent years, that more could be done to maintain health through dietary reform by supplying deficiencies in diet than by drugs or any other agency we know of. The study of the nutritive values of Indian foodstuffs is of the utmost importance to-day and the medical man would have great success in the treatment and " prevention of disease if he gave more attention to man's nutrition and the sociological factors governing his every-day life."

* * *

In a paper entitled " Lethal Properties of Aqueous Extract of Young Bamboo Shoots" (*Indian Med. Gaz.*, 1933) Stewart and Moorthy give an account of their preliminary observations on the active principles of young bamboo shoots responsible for the larvicidal and insecticidal properties. It has been shown that free hydrocyanic acid is liberated due, probably, to the enzymic hydrolysis of cyanogenetic glucosides present in the bamboo shoot and the observed toxic effects on guinea-worm embryo, cyclops, maggots of the house-fly, adult flies, adult mosquitoes and eggs of *A. stephensi*, may be due to the hydrocyanic acid so liberated. There appears to be a second substance also responsible for the toxicity, the nature of which is being investigated.

* * *

An ordinary meeting of the Association of Economic Biologists, Coimbatore, was held on 4th September, for discussing original papers. Mr. T. S. N. Singh gave a paper on " Chromosome Numbers in the Genus Saccharum and its Hybrids," describing the chromosome numbers, both interspecific and intergeneric. The various forms now grouped under Saccharum spontaneum showed chromosome numbers varying from 27 to 64. In the case of Saccharum hybrids, the doubling on the mother side noticed by Dr. Bremer was not found in certain of the hybrids with Indian canes. A series of four bud sports obtained from Co. 213 showed different numbers from 46 to 62; the one with 46 being apparently a degenerate type.

Messrs. T. V. Ramakrishna Ayyar and S. Ramachandran gave a very interesting paper on " Bees and Bee-keeping in South India". A brief account of the honey bees we have in S. India and the native methods now in vogue all over India in artificial bee-keeping and honey gathering were described. The paper also gave a short account of the attempts which are being made by the Entomology section at the Agricultural Research Institute, Coimbatore, to demonstrate and popularise the modern methods of bee-keeping as is practised in many of the Western countries.

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The Magnetic Interference Balance originally developed in Prof. S. S. Bhatnagar's Laboratory at Lahore has been put on the market by Adam Hilgers. This is a refinement of Oxley's magnetic balance in which the change in the inclination of a glass plate suspended by a bifilar suspension in one beam of a Rayleigh Interferometer is made evident by the movement of a system of Interference bands. The sensitivity of the balance is very high, as it is possible to read changes in the interference pattern up to a fraction of a fringe. A compensation arrangement is provided in the

instrument by which the fringes could be brought back to their original position and readings taken in terms of the movement of a graduated drum-head. The instrument is very compactly made and easy to set up. The balance is especially suitable for the investigation of weekly dia- or paramagnetic materials and for comparative measurements on closely related substances, but for work not demanding the great sensitivity of the interference method arrangement is provided whereby the original Oxley method may be employed.

With the growing importance of the subject of magnetism the balance fulfils a great need of the research worker in the field of magnetism.

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We have received from Messrs. Bailliere, Tindall and Cox, 8, Henrietta Street, Covent Garden, London, W. C. 2, a catalogue of their latest publications in Medicine and Science. The catalogue is arranged in four sections: (1) Medical, Dental and Nursing, (2) Veterinary Foods and food inspection, Botany and Agriculture, (3) Science and Miscellaneous, and (4) Periodicals and Reports. The catalogue also includes subject and author indexes, and will prove useful to Libraries, Government Departments, Institutions, Hospitals, etc., requiring latest publications in these progressive sciences.

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We acknowledge with thanks the receipt of the following:—

"Nature," Vol. 132, Nos. 3328 to 3332.

"The Chemical Age," Vol. 29, Nos. 737 to 741.

"Canadian Journal of Research," Vol. 9, No. 1.

Do. do. Vol. 8, Index.

"The Journal of Chemical Physics," Vol. 1, No. 8.

"Experiment Station Record," Vol. 69, No. 1.

"Communications from the Kammerlingh Onnes Laboratory of the University of Leiden"—217 to 221.

Do. Supplement No. 69 to Nos. 205-216.
Do. do. No. 70 to Nos. 217-228.
Do. do. No. 71 to Nos. ,,
Do. do. No. 72 to Nos. ,,
Do. Vol. 19, Nos. 205-216.

"Journal de chimie Physique,"—Tome. 30, No. 7.

"The Mathematics Student," Vol. 1, No. 2.

"The Review of Scientific Instruments," Vol. 4, No. 8.

"The Scientific Indian," Vol. 10, No. 56.

"The Indian Forester," Vol. 59, No. 9.

"The Quarterly Journal of the Geological, Mining and Metallurgical Society of India," Vol. 5, No. 1.

Do. Index to Vol. 3, Nos. 1 to 4.

"Bulletin of the State College of Washington, Agricultural Experimental Station," Nos. 282 to 285.

"Contributions from the Boyce Thompson Institute," Vol. 1, Nos. 1-8; Vol. 2, Nos. 1 to 10, Vol. 3, Nos. 1 to 4; Vol. 4, Nos. 1 to 4; Index to Vols. 1 and 2 and Profession Papers 1 to 22.

"Indian Journal of Physics," Vol. 8, No. 1.

"Transactions of the Mining and Geological Institute of India," Vol. 28, No. 2.

Reviews.

THE MEASUREMENT OF AIR FLOW. By E. Ower, B.Sc. (Lond.), Hons. I., A.C.G.I. Second Edition, Revised and Enlarged. (Chapman and Hall, Limited, London, 1933. Price 15*s.* 6*d.* net.)

The second edition of this book dealing with the theory and technique of the measurement of air flow will be welcomed by all hydrodynamicians, who are interested in practical application of their subject, by engineers engaged on matters, such as fan engineering and ventilation of mines and buildings, and by meteorologists in connection with the theory of anemometers.

For the purpose of fluid measurements, direct methods are inapplicable, and it is therefore necessary to resort to the measurement of some physical effect arising from the motion. Three such effects have been found by experience to be suitable, namely, pressure changes associated with the motion; mechanical effects, such as the rate of rotation induced in light vanes suitably placed in the stream; and lastly, the rate of cooling of a hot body, such as an electrically heated wire introduced into the air current. The author describes in successive chapters the general principles of the pressure tube anemometers, design of pitot and static tubes, the flow of air in pipes, measurements of flow and resistance with pitot-static tubes, the plate orifice, Venturi tube, and shaped nozzle, the vane anemometer, miscellaneous methods of flow measurement depending on pressure observations, manometers, and methods of flow measurement based upon the rate of cooling of hot bodies. In the last chapter, a few typical examples have been given, from practice of the methods of measuring air flow.

The author's own researches have contributed largely to the theory of the vane anemometer and have led to important practical conclusions. For instance, it is shown theoretically that the angle at which the vanes of an anemometer must be set in

order that they may commence to rotate at as low a speed as possible is 31°. Actually, from experiments, the best blade angle for an anemometer appears to be about 40°. But on account of uncertainty regarding the variation of frictional and interference effects that exist at very low speeds, the discrepancy of about 9° between theoretical and experimental values is not regarded as excessive. Another practical rule deduced from theory is that in order to limit the error on indicated air speed to 1 per cent., an anemometer should not be used in a pipe of diameter less than six times the diameter of the anemometer.

The details given in the book of the dimensions and other factors of the various air flow gauges will be found to be of great importance by research workers in the field.

While such an instrument as a Kata Thermometer has found a place in the book for the measurement of air speed, we miss any account of the method of measuring air flow by "floating particles" or "smoke or filament lines", which are finding increasing use in modern aerodynamic practice, particularly in regard to turbulent motion.

S. K. Banerji.

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Practical Chemistry (For Intermediate Science Students). By N. M. Shaw. (Published by the Students' Own Book Depot, Dharwar. Second Edition. Price Rs. 1-8-0.)

Introduction of a few exercises on the determination of the composition of gases like ammonia, hydrogen chloride, etc., would be very desirable. The portion of the book dealing with qualitative analysis shows that much stress is laid on dry tests; no doubt they very often give useful clues regarding the nature of the substance. Otherwise the book is quite suitable for the Intermediate students of all Universities.

M. Seshaiengar.

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Applied Chemistry Reports, Vol. XVII. 1932. (Society of Chemical Industry, London.)

The progressive chemist looks forward to the publication of the Annual Reports as a study of it enables him to keep himself abreast of progress achieved in various branches of Applied Chemistry. The obvious importance of such publications need hardly be emphasised. The flood of papers flowing into various Journals published in various parts of the world, thanks to the numerous fertile fields of Research in Applied Chemistry, makes it almost impossible for any Chemist to study all the literature, and he has therefore recourse to the annual reports and looks upon it as an essential addition to his library.

Nearly 3,300 references have been cited in the current publication comprising 26 different sections prepared by well-known specialists. The section on Explosives comprises work for the two years 1931 and 1932, a review on the subject not having appeared in the previous year. The Annual Reports appear in very familiar style, and deserve a merited place in every library.

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Romance of Plant Hunting. By Capt. F. Kingdon Ward, F.R.G.S. (Edward Arnold & Co. London. Price 3*s*. 6*d*.)

We have read Capt. Kingdon Ward's book on "The Romance of Plant Hunting" and judging from the material and the method of treatment, we have no hesitation in welcoming it as an addition to the works on Scientific exploration and travels.

"Full many a flower is born to blush unseen" and the plant hunter very piously sets before himself the arduous task of discovering these "Unseen" blooms and presenting them as gifts to the lovers of the beauty of nature. The task is rendered not merely difficult but full of enterprise as the hunter in search of new and hardy plant has to explore regions of the earth untrodden by man. Captain K. Ward takes us in a very racy and attractive style, through Yunnan, the Land of the Yellow Lama, where nature is a vast festival of multi-coloured flowers.

As a guide to the art of plant collection the book is an invaluable asset and gives us certain very timely and suggestive "tips". The first concern of the plant hunter is to secure for the civilised world a first class plant which for fragrance, colour, habit and abundance of flowers commands great admiration and respect. In several cases the plant may not survive the changes of habitat and it is a great responsibility on the part of the plant collector to give as accurate a description of the original habitat of the plant as possible to enable the plant breeder or horticulturist to duplicate the natural environment and in this respect also Kingdon Ward has justified the expectations of the reader.

The inherent love of flowers by the Englishman is the result of the climate and his roving disposition and the uncanny skill of an English gardener places him almost in the front rank of the gardeners of the world. The result of this is that the English garden is the envy of the world and the enviable position of the British as gardeners of taste and beauty is largely due to the labours of the scientific or the professional plant-hunters. In the West, people are accustomed to celebrate seasons when flowers are in blossoms with mirth and gaiety and the custom is seen to a limited extent in Oriental countries like Japan and China where form and colour appeal to the æsthetic sense of the people to so great an extent that the time of Cherry blossoming is a national festival with them. There is this difference between the Orient and the Occident: while in the latter it is beauty of form and colour that are the sole points, in the former there is always a touch of religion. The Japanese like the Indians worship trees in their temples and every month in the year has some plant dedicated to it. We hold that the Lotus is sacred to Vishnu and the Labiatæ sacred to Shiva.

We have no hesitation in suggesting that books of the type under review contribute in a large measure towards educating public taste creating a sense of the beautiful in nature and incidentally promote a sense of responsibility in the endeavours of the amateur plant collectors to discover, foster and perpetuate the "Unseen" beauty in the plant kingdom.

A. N. R.

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A PROBLEM IN EVOLUTION.—In recent years the controversy regarding the precedence of function or habit over form or *vice versa* has been revived with considerable vigour. Several workers have denied the existence of "adaptations" and believe that characters have arisen at variance with the innate tendencies of "heredity". In a recent article (*American Naturalist*, **47**, pp. 154-162, 1933) entitled "The Fishes of Lake Lanao: A Problem in Evolution" Dr. Albert W. C. T. Herre of the Stanford University, California, corroborates the views expressed by Regan (*Nature*, **113**, p. 569, 1924) that evolution in its main lines has been adaptive and that "changes in structure have been intimately related to, or even determined by, changes of function. As a result of extensive field-work, Dr. Herre has discovered a unique endemic fish fauna in the Lake Lanao which comprises exclusively of the Cyprinoid species. Dr. Herre believes that the seventeen or more species of Cyprinidæ found in the lake are descended from a single parent stock. It has to be remembered that the present lake was once a mountain ravine, which was dammed by lava flow long ago, and gradually the mountain stream changed to a large lake with a great diversity of conditions. Thus, according to Herre, "the changing conditions in the lake, with all its varied assortment of environment, imposed new demands upon the parent stock of fishes and eventually various new forms of more or less permanence or fixity appeared, some of which survived while others may have disappeared." The parent species is believed to be *Barbodes binotatus*, which, with the formation of the lake, became transformed into *B. tumba.* The latter is now to be found in the rapid waters of the small tributaries of the great lake. As Lake Lanao attained maturity, various offshoots from *B. tumba* arose, each with special adaptation for a particular environment. One set of species took up life in the clear blue surface water lying offshore in depths of 5 to 15 metres. One species has become adapted to life at a greater depth. In shallow, muddy bays black or dusky bronze species have appeared. There are others that live in the boiling eddies and swirling mad torrent of the Agus, the outlet of Lake Lanao. Between these, there are intermediate forms found in the intervening zones. Some of the descendants of *B. tumba* are so remarkable that they have been referred to new genera. Dr. Herre's interesting account of these species illustrates very clearly that "some form of isolation or habitudinal segregation is the condition of the development of a new species (Regan)". It further shows that "as a rule the first step in the origin of a new species is the formation of a community with a new and restricted environment, or with new habits" (Regan). Dr. Herre concludes that "From the outline given it can be seen that the fishes of the Lanao plateau present a highly interesting problem to the student of evolution, one which would repay an intensive study. Something has been presented here from the unfashionable viewpoint of the field naturalist, in the hope that some modern technician might take up the study of the *Lanao cyprinidæ*."

S. L. H.

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THE HOUSE THAT FREUD BUILT. By Joseph Jastrow, Ph.D., LL.D. (Rider & Co., Paternoster House, London, pp. 252. Price 7*s*. 6*d*. net.)

When the theory of the "unconscious" was announced, Dr. Sigmund Freud was acclaimed as the Darwin of the human mind and among the numerous ramifications to which this fruitful generalisation gave rise, the general public is most familiar with the principle of psychoanalysis. The Œdipus complex—one of the numerous complexes developed by this doctrine—it is well known to literary circles, seems to have provided a satisfactory explanation of the hesitancy of Hamlet in killing his mother, as expressed in his famous soliloquy, and numerous instances from Red Gauntlet, Tom Jones and other novels must occur to the reader's mind as illustrations of some principle or other of Freudian psychology, which also provides an answer for obscure mental phenomena like hysterical obsessions, slips of tongue and pen and dream experiences. The cause for their manifestation is that during waking hours, the mental censor is imposing restraints on the repressed antisocial wishes which lie dormant in the mind and when the censor is caught napping, as during sleep or moments of unawareness, they find a symbolic expression. Similarly, fear due to any terrible accident which one might have forgotten, may, at the suggestion or repetition of the dreadful experience, be regarded as a factor in producing paralysing effect on the mind and body. Freudianism conceives the human mind as a sewer the contents of which are reprehensible wishes and dreadful fears of childhood experiences of which it is not in ordinary moments aware, or dare express in society and the sewer is enriched every time such wishes, fears and hallucinations are repeated.

The book subjects this fashionable doctrine of psychoanalysis to a critical investigation and its immediate purpose is to examine the symptoms and their interpretation in the Freudian exegesis. The first part of the book is devoted to a statement of the facts and principles of the Freudian system which in its ramifications is intended to cover the entire range of the human psyche.

The second part is devoted to a critical examination of the foundations and the superstructure of this edifice and the inevitable conclusion is reached that they are based on untenable assumptions and fallacies. The psychoanalysts adopt the principle that everything is sex and sex is overall. The human mind and its motives are also something nobler in their intellectual, emotional and spiritual relations and operations and although the sex instincts impart a tinge to some of their manifestations, it would be illogical and unscientific to see sex and nothing else in all human actions, thoughts and even dreams. The second part of the book is a protest against the sex-jaundice of the followers of Freud and the dispassionate reader is left in no doubt as to the attitude of Jastrow who finds not even the slightest warrant of biological, physiological and psychological justification for Freudian illogicalities. Stripped of all the grosser accretions and extravagances, the main hypothesis is certainly a notable contribution to genetic psychology. The technique devised by the psychoanalysts is no healing balm to mental disorders and persistence in this madness must be a hindrance to the orderly and scientific progress of our understanding of the deep-seated troubles arising from more causes than those of the suppressed memories of infantile sex experiences. Psychoanalysis has become a dogma and threatens to hinder the free growth of knowledge.

The book is written in a perfectly frank and scientific spirit. The style is clear and vivid. The arguments are perfectly logical and cogent. The weak points of Freudian psychology are exposed without animus. Its strong features are supported without hesitation. The book helps the reader "to absorb that part of Freud which is most helpful to straight thinking and pleasant living." We have pleasure in praising the excellence of the book and in congratulating the author on his splendid performance.

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THE PSYCHOLOGY OF POWER. By J. A. Hadfield, M.A., Macmillan & Co., Ltd., St. Martin's Street, London, 1933. Pp. 1-49. Price 1*s*.)

This interesting booklet represents a new edition of the paper originally contributed by the author to *The Spirit* (1919) one of the popular series of volumes produced by the "Cumnor Group" and is intended to meet a widely-expressed demand for its republication. The main question which this essay purports to solve is whether energy comes from within ourselves as we acquire it from food and periodic rest or are we mere channels of energy, which is to be regarded as some impulse that works through

us and is not of our making. This is undoubtedly a fascinating problem for spiritualists, theosophists and introspective philosophers and the terms of the question are not strictly scientific in the sense that they are capable of experimental treatment. The liberation of energy in excess of the normal under hypnotic suggestions is not an argument in support of the thesis, for the subject under their influence is drawing upon his reserve. If highly seasoned food should whip up the replete stomach to put forth fresh effort, the glutton relies more upon the mechanical properties of this organ than on those of spices to accommodate the additional mass. Hadfield's view that man's ultimate energy is derived from cosmic source may satisfy certain schools of thought represented by speculative philosophers and it offers no explanation to the significance of the chemical reactions of the tissues and the cells being regarded as the storehouse of energy.

In the section on fatigue, we are told that irritability, want of confidence, worries and anxieties are a fruitful cause. But the common denominator of all these causes is "monotony" and if this element could by any possible means be eliminated from professions and occupations, Hadfield's causes of "fatigue" will disappear.

The subject of energy is part of physiology and not of psychotherapy. The book will be welcomed by all interested in psychic researches.

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ECONOMIC MAMMOLOGY. By Junius Henderson and Elberta L. Craig. (Bailliere, Tindall & Cox, 7-8, Henrietta Street, Covent Gardens, London, W.C. 2. Pp. 397. Price 22*s*. 6*d*.)

We have read this sumptuous book with considerable interest and profit and it will doubtless be found extremely useful not only to students of biology but also to those engaged in trade and manufacture and to statesmen in charge of public finance. The wealth of information presented within the compass of 347 pages ranges over an immense field and its usefulness to the economist, statistician, sportsman and the general reader can hardly be over-estimated. The first part of the book deals with facts and principles relating to economic mammology and the second part is devoted to a systematic discussion of the several groups comprising this class of animals, together with statistical data and references to literature.

The man in the street can hardly realise the important rôle played by mammals in his social and political economy. The different kinds of meat forming the world's daily menu, the milk and milk-products, fats and oils, wool, furs, skins, horns and antlers, teeth, animal compost, bone meal and fertilizers constitute a great part of the industrial organisation of the country and a source of national wealth. There are a few mammals like the rodents which destroy the crop and others like the carnivores, prey upon fish and fowls and other animals in the service of man. Hitherto the interest of the Government has been confined to the taxation of the industries and the exports and imports of the mammalian products. The indiscriminate zeal of sportsmen in the pursuit of their pleasure has disturbed the balance of nature whose consequences to science and industry he can hardly judge. The theory that wild animals of economic importance are part of the property of the state and are therefore entitled to protection has been recognised only recently and the laws framed for this purpose are not generally honoured in the observance. The study of mammals as useful scavangers, as carriers of diseases, as practical agriculturists in turning over the soil, as agents in causing erosions or in endangering dams, dykes and reservoirs and the part they play in offering inducements to exploration of virgin lands and their occupancy by settlers, is not only a chapter in the romance of Natural History, but is a fundamental section of economics. The central fact in American History and the expansion of the early settlers over the whole continent is closely bound up with that little animal called beaver. Similarly, whales and whaling industry have played an important part in the exploration and international disputes. Mammals have unconsciously influenced the fashions and artistic tastes of man whose whole course of civilisation is related in a considerable measure to wild life.

The importance of the book to the tradesman, economist, politician, biologist and to every one who claims to be educated, is invaluable.

* * *

INORGANIC COLLOID CHEMISTRY. Vol. 1, The Colloidal Elements. By Harry B. Weiser, Professor of Chemistry at the Rice Institute. (New York: John Wiley & Sons, Inc. London: Chapman and Hall, Limited, 1933. Pp. xi+389. Price 28*s*. net.)

Apparently the author—who must be familiar to colloid chemists as the editor of the series of Colloid Symposium Monographs (appearing since 1930 as the Colloid Symposium Annual)—feels a need for stressing a difference of outlook in the field of colloid science, and indeed the object of the author is to "emphasise the importance of colloid chemistry of the elements and their inorganic compounds" to the student of inorganic chemistry. Actually the book will be welcomed by all students of chemistry, and particularly by those who are not already specialists in this branch of research, as it includes an admirably clear, concise, and critical presentation of the theories and some of the applications of colloid science.

The present book forms volume I of the subject, and is concerned mainly with the colloidal elements and the important rôle they have played in the development of the theories. "After a chapter dealing with the general methods of preparation, separate divisions of the volume are devoted in turn to the metals and the non-metals. In so far as practicable the several elements are taken up in the order in which they appear in the periodic table. In the descriptive portions of the text are included the methods of procedure for preparing the several sols and for investigating their characteristic colloidal properties", and in several cases enough experimental details are given for guidance in laboratory work. The first part dealing with the metallic elements includes a useful 30 pages devoted to the theory of adsorption of gases by metals, and another 40 pages to the theory and use of colloidal metals as contact catalysts. In the second part dealing with the non-metallic elements, carbon, sulphur, selenium, tellurium, and iodine, there is a critical 30-page survey on adsorbent carbon. There are more than a thousand foot-note references to the literature, many of them to important papers that have appeared in the last few years, which will serve as a valuable guide to original research.

The book is by no means a mere compilation. The major part of it can be read with pleasure. There are a number of diagrams which are excellently drawn and aid in the clarity of presentation. All told the volume is a welcome addition to the existing books on Colloid Chemistry. G.R.

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CHEMISTRY AND PHYSICS FOR BOTANY AND BIOLOGY STUDENTS. By E. R. Spratt, D.SC., F.L.S., A.K.C. (University Tutorial Press, Ltd., 1933, Second Edition. Pp. vi+284. Price *3s. 6d.*)

This book is designed to provide the material for a course of instruction in Elementary Physics and Chemistry for students of Elementary Botany and Biology of the Oxford and Cambridge School Certificate Standard.

Twelve out of the 21 chapters of the book deal with Elementary Physics: Properties of Matter, 6; Heat, 4; Light, 1; and Electricity and Magnetism, 1. The remaining nine chapters are devoted to a study of Elementary Chemistry: Physical Chemistry, 2; Inorganic Chemistry, 5; and Organic Chemistry, 2.

The subject-matter of each chapter has been presented in a very intelligible fundamental manner combining theoretical statements with practical illustrations in the form of simple experiments which can be easily carried out with inexpensive apparatus. Directions for carrying out seventy-nine such experiments are given under the chapters on Physics and eighty-nine such, under Chemistry.

The comprehensive yet elementary character of the subject-matter will be clear from the nine experiments under the chapter on "Light" which illustrate the Pinhole Camera, the Reflection at Plane and Spherical Surfaces, Refraction and Refractive Index; properties of lenses and microscopes and production of spectral colours. The essentially practical and realistic feature of the experimental material is best brought out by the two experiments under Organic Chemistry which describe the production of gas, liquor, tar and charcoal by the dry distillation of coal and other vegetable matter.

The book is throughout adequately illustrated with 128 diagrams of apparatus used for the various experiments. Very few errors are noticeable except perhaps the use of the terms "Adhesion" and "Cohesion" on pages 5 and 6; "Alcoho" for "Alcohol" on p. 246 and the equation on pp. 162 and 177, $CaO+H_2O$ which is better written as $Ca(OH)_2+CO_2 \rightarrow CaCO_3+Aq$.

The book bears full evidence of being the work of an experienced teacher and can confidently be recommended for adoption in Indian schools as a suitable aid to impart the essential preliminary knowledge of Physics and Chemistry to students of Elementary Botany and Biology.

V. P. R.

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Science and Industry.

It is not generally realised, even by promoters of Industry, that Science and Industry are no more closely related to each other than Philosophy and Religion. It is indeed true that Science provides the basic material for the development of Industries: it should also be admitted that no industry can prosper unless scientific methods are adopted. On the other hand, Science plays only a small part in the organisation of industry. The scientist is only an humble unit in the machinery that is engaged on the conversion of a cheap raw material into a valuable finished product which the consumer buys. The work of the scientist constitutes the foundation on which the industry is built and which, in consequence, should be safely and securely laid. It does not, all the same, constitute the entire structure. The scientific worker is fitted to lay more foundations and even strengthen the existing basis, but the main structure must be built by others. It would be of much assistance, therefore, to the progress of industry if the significance of the above could be realised by all concerned, so that there need be no delusions regarding the rôle of the scientist in industrial organisations; so that his talent may be more usefully employed in the conduct of fundamental researches leading to new industries or in solving technical difficulties relating to the existing ones rather than be diverted into lines of work for which he is not fitted and wherein he may prove a failure.

The truth of this position is, no doubt, realised by the more progressive industrialists, who collect together the right types of talent and organise them into a homogeneous machinery that constitute the prosperous industry. On the other hand, it is not appreciated by many others, particularly in India where the management content themselves with finding the necessary funds and leaving it to their scientific staff to become also the manufacturers, advertisers and even salesmen! The result is that the scientist is obliged to neglect or put off his legitimate duties. He is not generally fitted by either temperament or training for the different types of operations that he is called on to undertake so that, more often than not, he fails in such ventures. Ultimately the industrial venture also proves a failure and the poor scientist comes in for general censure.

A critical inquiry into the failure of a number of industrial concerns both in India and abroad would reveal that most of them are due to faulty organisation. There is no doubt that certain important factors like the cost of raw materials, efficiency of the processes involved, demands of the market, external competition and the nature and extent of State assistance that largely determine the success or otherwise of any industrial venture, but being given favourable conditions, the prosperity of a concern depends almost exclusively on its efficient organisation. The right type of talent for each particular operation should be found and then fitted into the right place. It is the efficiency of this process that determines the ultimate success of an industrial venture.

It is, perhaps, no exaggeration to state that some of the biggest industrial organisations of the World, like several other great ventures, are essentially the creations of single brains. It is that master-mind which first conceives of the venture, selects the right kind of staff and co-ordinates their work into a homogeneous organisation. Such were Ludwig Mond in England, Alfred Nobel in Sweden, Andrew Carnegie in the United States and Jamsetjee Tata in India. Industrial geniuses of that type are, however, very rare. More often than not the business is managed by small groups of men, sometimes not more than two or three, who understand each other perfectly, who make up for each other's shortcomings and work as a unified body. A management of that type would also possess the requisite vision, the right type of scientific as well as business outlook, necessary skill in the choice of staff and the co-operation of their workers. The success of many of the present-day ventures depends on the efficiency of the combination that constitutes the management.

Now the question arises as to whether the management should consist of business men with the necessary scientific outlook or whether it should also include scientists. A scrutiny of the compositions of the administrative councils of the more progressive industrial concerns in different parts of the world would show that most of them include representatives of the branches of science relating to the industries concerned. Unfortunately, such is not the case in India. More often than not, the management consists of business men—clever, cool-headed in their own ways—but sadly lacking in scientific outlook, with the result that they are out of tune with their works and research staff at whose tender mercies they are often placed for the progress of their venture. The result is that the technical staff determine the policy of their heads and assume more powers and responsibilities than they could do justice to, with the result that the major issues of production and distribution are obscured and the venture proves to be far less successful than it could otherwise be. Sometimes the reverse also happens. The management—non-scientific in outlook—starts with an aggressive hand, with scant courtesy for the opinion of their technical staff, so that the latter is compelled to bow down to their ideas—often unworkable—so that the venture loses in efficiency and ultimately proves a failure. It would be seen from the above, therefore, that the combination of the scientific and the business outlook is essential to the success of any industrial organisation. Where the business men lack the necessary scientific outlook, the proper procedure for them will be to choose scientific men in whom they have some confidence and plan out things in conjunction with them before launching out on their ventures. The representation of scientific interests in the management ensures a certain amount of sympathy and friendliness for the technical staff, as also appreciation of the difficulties involved in the various operations which go to make the industry. No industrial venture will prove successful unless there is proper understanding and close co-operation between the management and the technical staff, and sooner this is realised by those interested in industries, the better it will be for their ventures.

In recent years, several industrial concerns, particularly in India, have proved unsuccessful chiefly because of the over-lapping of the purely scientific and the 'works' staff engaged on the manufacture. It would be of much assistance, therefore, to critically examine the parts played by the two groups of workers in a well-organised factory. The research scientist provides, no doubt, the basic material for the venture. He conducts the necessary preliminary trials—all on small scale—standardises the conditions for the different operations and then passes on the details to the works staff who follow up the idea on commercial scale. It is very rare, however, that the operations lend themselves straightaway to development on bigger scale. More often than not some of the steps which

prove easy in the laboratory turn out to be highly difficult on factory scale or prove too costly to be commercially successful. Some of the difficulties can be overcome by the works staff themselves who can modify the technique to suit their requirements, but cases often arise when the problems will again have to be referred to the scientific staff who will have to devise new methods of managing the operation more efficiently. In this manner there is frequent swing of technical researches between the laboratory and the factory until all the related processes are carried out to perfection. Even then the scientific staff will have to go on with their work, trying cheaper raw materials, alternative methods of manufacture or otherwise go on improving on the process so that the cost of production may be brought down to the lowest possible limit and products of the best quality can be made available at very small cost to the public. It is only then that the process will be in a position to hold the commercial field and face continuous external competition successfully. In India, on the other hand, the purely scientific work of the laboratory is made to overlap with the large-scale operation in the factory, the same staff being employed for both the purposes. In a few places there is some distinction, but it is only in name because the qualifications and the experience of both the groups of workers are of the same order so that the result is, more often than not, highly unsatisfactory.

The above defect is partly due to want of sufficient knowledge of the respective positions of the two groups of operations in an industrial organisation and partly to dearth of the right type of talent, particularly for the management of large-scale operations. There are still several industrialists who are slow to realise that the pure scientist, while being eminently suitable for the laboratory work, is not really qualified for the factory operations. In fact, it will be a waste of talent to divert the research scientist from the laboratory where he can do useful fundamental work to the factory. The managements of many industries are not, however, sufficiently alive to the significance of this weak point in their organisation and make the mistake of trying to save money by employing the same persons to look after both the laboratory research and the commercial operations. The result has rarely ever been satisfactory.

The question naturally arises as to what types of talent are required for the two main groups of technical operations in the industry—scientific research on the one hand and factory production on the other. We will first consider the requisite qualifications of the research scientist, because his work constitutes the basis of the industry. He must naturally be an expert in the related branch of science and possess the necessary imagination to determine how the scientific work should be directed so as to yield the final product at minimum cost. He must have an idea of the prices of the materials he works with, so that he may avoid the use of the more expensive ones if others, equally efficient, can be obtained at lower cost. He must be quick and energetic and be alive to the fact that the rapid solution of the basic principles determines either a successful patent or some quick advantage over other rivals in the field. The industry and skill of the research scientist may often make all the difference between large profits on the one hand and heavy losses on the other. The scientist must also have some idea of the difficulties involved in the translation of his processes into large-scale operations. His methods should also be so planned as to suit, as far as possible, the available equipment in the factory. He need not be an engineer but he must have some idea of the possibilities of the available machinery before advising his factory colleagues to carry out his plan of operations. By so doing, an expert research scientist would eliminate many of the difficulties to be encountered in the factory or, at any rate, so minimise them that the technical process soon becomes an accomplished success. The type of talent required for the purely scientific work in a factory is now being turned out by most Universities and Research Institutions in different parts of the world. It may not be very difficult, therefore, to choose the right type of men for conducting the purely scientific work leading to the organisation of Industries.

The choice of the works staff, on the other hand, is very much more difficult, the chief reason being that the right type of talent is not available. Taking the chemical profession for instance, there are, perhaps, a few thousands in India alone who possess the requisite scientific knowledge but there are very few among them who have had the necessary works experience for conducting operations on commercial scale. The fault is not entirely that of the scientist. It is no

doubt true that many of them do not have either the interest or the inclination for the type of work that a factory demands, but there are also several others who, in spite of their keenness to learn, do not get the opportunity for the right kind of training. Although hundreds of scholars have gone abroad in recent years either at their own expense or that of the State, for training in industries, only a few of them possess the requisite experience for initiating such industries. Most of them would, in fact, appear to have diverted their interests to purely laboratory work partly because the factories were more or less closed to them and partly because there still persists, in every part of the world and particularly in India, much glamour for higher degrees which are much more easily obtained through the laboratory than through the factory. It is this defect in the technical training of the staff, as also want of proper scientific outlook on the part of the management, that have been largely responsible for the non-expansion of several of the existing industries in the country or the failure of many of those that were started during recent years. These defects must be remedied at once for, otherwise, it would be very hard to envisage any useful industrial development in the country.

The question which naturally arises is, how is the condition to be improved? The factories in other countries would naturally close their doors to their would-be rivals. It is very doubtful if even the few factories now working in the country would be prepared to provide training that will lead to the development of similar industries elsewhere. It becomes necessary, therefore, that training in factory operations should be provided in public institutions specially equipped for the purpose. A move in that direction is already in progress in some parts of the country and it is not unlikely that the different technological institutes will soon turn out competent men who could carry out the factory operations relating to different industries.

In modern times, with numerous rival organisations and hard struggle for existence, no industrial venture will be successful without the aid of adequate advertisement and sales agencies. It is not within the purview of this contribution to consider the organisation of these two important lines of activity, but it should be emphasised that they are outside the scope of the scientist, who should not be asked to shoulder them.

Now what is to be the organisation for the development of new industries? It is a vast subject by itself: so we will confine our present remarks to those that relate to the scientist in the factory. It is often suggested that the scientist should come forth with the ideas and methods and get the business man interested in the possibilities of the venture. Some would even go further and suggest that the scientific man should also work out the costs, and demonstrate the working of the factory on a small scale; that he must also study the demands of the market and undertake the disposal of the product. There are probably a few men and women in the world who can manage all the above-mentioned operations successfully, but the majority cannot hope to do justice to more than one each. In the more progressive countries, the idea of a possible industry first originates in the mind of the man with some money and the necessary liberal scientific outlook. He then studies the possibilities of a venture, investigates the trade returns in the particular industry and, if the conditions prove encouraging, he proceeds farther to discuss the possibilities with the scientist, who is an expert in the particular branch and the engineer with the requisite works experience. He then provides funds and facilitates for systematic scientific work either in a place attached to his factory or in a research institution where the operations could be carried out on a small scale. If the preliminary researches prove encouraging, the process is then tried on semi-commercial scale at a place where the required equipment could be had. If this also proves successful, the process is then transferred to the factory where the operation could be carried out on the necessary large scale. The other sections of the organisation will then naturally follow.

It would be seen from the above that although the scientist plays a very important part in the development of industries, there is yet much in the organisation for which other types of talent are required. The future development of industries in the country depends, to no small extent, on the right type of organisation and if this contribution has brought home a few fundamental facts relating to it, then our efforts would not have been in vain.

Organic Manures and Plant Nutrition.

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and
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THE importance of organic manures in agricultural practice has been recognised from the earliest times. In ancient China, as also, to some extent, in Aryan India, the utilisation of different forms of organic waste materials as manures was regarded as an important item of field operation. In the early days, as also in the centuries that followed, it was believed that the plant derives the bulk of its food from pulverised soil and manure together with water. The importance of cultivation was therefore greatly stressed upon and farmers ploughed their lands to bring it to a consistency suitable for direct intake of soil materials by the plant.

The discovery of the fertilising value of nitre and various other mineral salts, as also the increasing evidence to show that the plant derives the bulk of its organic material from the carbon dioxide of the atmosphere, brought about a rapid change in scientific opinion regarding plant nutrition by about the middle of the last century. The later exponents of agricultural science naturally argued that the plant depends on soil only for its supply of water and mineral salts and that the application of bulky organic manures is not only expensive but also quite unnecessary.

Many practical farmers, particularly those of the older generation, did not, however, accept the new theory of plant nutrition. They continued to believe in the efficacy of farmyard manure and would not use the new mineral fertilisers except in small doses and that in combination with organic manures. Their cautiousness did not meet with the sympathy of the younger generation, but subsequent experience has justified the wisdom of such a policy. (1) Mineral fertilisers are not consistent in their action. In favourable seasons they are as good as or even better than organic manures, but in seasons of drought or excessive rainfall they have often proved highly disappointing. (2) Soils continuously treated with the same mineral fertilisers become increasingly acid or alkaline in reaction. The average yields from such areas tend to steadily diminish with time as compared with those of similar soils treated with organic manures. The observations on the permanent manurial plots at Rothamsted, Woburn and elsewhere lend strong support to this statement. (3) In horticultural practice, exclusive use of mineral fertilisers has, generally, proved unsatisfactory. Not only the yield but also the quality of produce is often reported to have suffered as the result of substitution of organic manures by mineral fertilisers. (4) In tropical countries, where soils are naturally deficient in organic matter, the response from exclusive use of mineral fertilisers has not generally been satisfactory. In many places, depressed yields, almost amounting to complete failure of crops, have been reported as the result of heavy applications of minerals in quantities corresponding to those adopted in European countries. (5) In recent years, a number of workers—among whom particular mention should be made of McCarrison and his co-workers at Coonoor and Viswanath and his associates at Coimbatore—have obtained evidence to show that grain and fodder crops raised on mineral fertilisers are comparatively less nutritious or otherwise poorer in quality than those raised on organic manures. The above and related observations have naturally led to the conclusion that organic manures play a more important part in plant nutrition than that of merely conserving moisture in the soil and reducing resistance to the plough as has so far been believed.

A careful analysis of the different possible ways in which organic manures can assist plant nutrition would suggest the following: (1) They may decompose in the soil releasing minute quantities of certain rare minerals which are essential to plant growth but are not provided by any of the known combinations of mineral fertilisers. (2) Some of the organic constituents of the manures themselves or the products of their decomposition in the soil may be directly assimilated by plants with beneficial results. (3) The decomposition of organic manures in soils may be accompanied by profuse evolution of carbon dioxide which would be

assimilated by plants growing thereon, thereby yielding heavier crops than would otherwise be possible.

With reference to the first suggestion, it may be mentioned that most organic manures are essentially of plant origin, so that the prospect of their containing rare minerals not ordinarily present in the soil is rather remote. It is also known that the main mineral requirements of plants are confined to a few well-known groups, while the others are required in such small quantities that most soils in the world may be said to contain sufficient quantities to meet the most exorbitant demands of crops, almost indefinitely.

Direct experimental evidence on this aspect of the problem has not, however, so far been adequate. A number of experiments were therefore carried out by the authors, adding varying quantities of the mineral residues of different organic manures, both by themselves and in combination with other minerals, to acid-washed sand and studying the effect thereof on plant growth. The experiments were carried out with a variety of plants and in different seasons: they were also repeated on a number of soils. As the result of a large number of observations, thus made, it is now possible to state, conclusively, that the commoner types of organic manures do not contain any rare forms of mineral matter that are essential to plant growth. The following observations which relate to one set of experiments would illustrate the above statement:—

Barley raised on	Average dry weight of seedling in mg.
Sand + Complete minerals ..	$42 \cdot 6 \pm 1 \cdot 7$
,, + ,, + Ash of farm-yard manure (by ignition)	$36 \cdot 8 \pm 1 \cdot 2$
,, + ,, + Mineral residues of farm-yard manure (after repeated treatment with hydrogen peroxide) ..	$37 \cdot 5 \pm 1 \cdot 6$

As already mentioned, the idea of organic manures or their products of decomposition serving as direct nutrients to plants dates back to the earliest times, though experimental evidence on this aspect of the problem is still inadequate. Particular mention should be made of the work of Wildier who noticed that yeasts do not flourish except in presence of an organic substance, 'Bios', present in beer wort, yeast water and such like media; of Bottomley and Mockeridge, who observed that growth of certain aquatic plants is not possible except in presence of certain substances, the 'Auximones', which are present in organic manures. Later researches, by a number of workers, have not entirely supported the observations of Wildier and Bottomley. The practical significance of such findings, in relation to field practice, is still not clear.

With a view to obtaining some direct evidence on this aspect of the problem, a number of experiments were carried out by the authors with pot-cultured plants. In one set of experiments, a number of organic substances were added to acid-washed sand, both by themselves and in combination with different mineral salts, and the effect thereof on plant growth studied. The experiments were repeated in different seasons and with various species of plants. In another series of trials, aqueous extracts of different organic substances were injected directly into the plant system and the effect thereof on growth and reproduction determined. The injections were also repeated at various stages of plant growth and in different seasons.

The observations on sand-cultured plants have shown that (*a*) even under carefully controlled conditions it is not possible to prevent the action of micro-organisms on the added organic substances, and (*b*) the effect produced by minute quantities of different organic substances, at any rate in the earlier stages of plant life, is indistinguishable from that produced by mineral fertilisers applied together with them. The following table presenting one set of observations would illustrate the position:—

Barley raised on	Average dry weight of seedling in mg.
Sand (1·5 kg.) + Complete minerals ..	$27 \cdot 4 \pm 0 \cdot 8$
,, + ,, + Dried blood (0·05 g.)	$26 \cdot 4 \pm 0 \cdot 4$
,, + ,, + Aqueous extract of dried blood (0·05 g.)	$27 \cdot 7 \pm 1 \cdot 0$

The injection experiments were first carried out with the sun flower plant (*Helianthus annus* Linn.) and then extended to

other species. The observations showed that aqueous extracts produce no appreciable effect on plant growth. Repetition of the experiments on comparatively mature plants showed, however, that minute quantities of certain substances produce an entirely different, but no less important, effect by increasing the proportion of flower and seed to the whole plant as illustrated by the following results:—

Fluid injected	Percentage (weight) of flower to the whole plant in mg.
Yeast extract	24·4
Farmyard manure extract	24·8
Soil extract	21·7
Distilled water (control)	13·1

The foregoing observations are of considerable practical importance and are now being extended to a large number of agricultural as well as horticultural plants with a view to (*a*) determining the nature of the constituents responsible for the effects observed and the mechanism of their action, and (*b*) devising methods of extending the treatments to field practice. The effects of injecting a number of new substances are also being studied. A number of new methods of direct feeding are also being tried.

There is evidence to show that (1) the carbon dioxide content of the air above a soil treated with organic manure is generally higher than that above a similar area which is either left unmanured or treated with minerals, and (2) when a soil is under vegetation, the carbon dioxide content of the strata of air below the leaves is higher than that above them. These observations combined with the fact that, other conditions being alike, photosynthetic assimilation is proportional to the concentration of carbon dioxide in the air, would suggest that the beneficial effect of organic manures is at least partly due to the enrichment of the atmosphere with that gas. On the other hand, it may be argued that, being a gas, carbon dioxide would get readily disseminated in the atmosphere so that plants raised on mineral fertilisers would receive about the same supply of that gas as those grown on organic manures. Moreover, it should be admitted that artificial enrichment of the atmosphere with carbon dioxide does not always lead to increased crop yield: in fact, the exhaustive researches carried out in Germany and elsewhere would show that many of the crops do not respond favourably to that treatment. As further arguments against the theory, it may be pointed out that (1) no experimental evidence has, so far, been obtained to show that plants can flourish in the absence of atmospheric carbon dioxide while it can be demonstrated by water and sand culture experiments that they can live and grow independent of organic manures, and (2) the quantitative carbon relations between the soil, the plant and the atmosphere have not been defined so that it is not possible to state as to what extent the increased production of carbon dioxide in a soil is due to the oxidation of the organic manure alone.

A critical analysis of the literature on this aspect of the problem would, however, reveal that (*a*) although plants can be raised in the absence of organic matter, yet the growths thus obtained are rarely ever so satisfactory as those on soils, particularly those which are naturally rich in organic matter or receive good dressings of organic manures, and (*b*) the previous workers who sought to increase crop yield by artificially enriching the atmosphere with carbon dioxide did not take the aeration of roots into consideration. There are very few plants in nature which can flourish without adequate root aeration, so that abnormal increase in the concentration of carbon dioxide around the plant would naturally reduce the supply of oxygen to the roots, which would, in consequence, suffer. The availability of carbon dioxide from organic manures would, on the other hand, be largely determined by oxidation changes in the soil which, in turn, are dependent on soil aeration, so that the two essential conditions, namely, adequate supply of oxygen to the roots and increased concentration of carbon dioxide around the leaves would both be satisfied at the same time. It may be concluded, therefore, that the evidence on this aspect of the problem is still incomplete and that further work is needed to define the nature of the relation between the decomposition of organic matter in the soil and photosynthetic assimilation of carbon dioxide.

With a view to throwing some fresh light on the above and related questions, a number of experiments were carried out, adding

organic manures to different soils and studying the attendant transformations, with special reference to the production of carbon dioxide and plant assimilation. The results may be summarised as follows:—(1) In the study of oxidation changes not only the added manure but also the organic matter already present in the soil should be taken into consideration. The latter is not only very much larger in quantity but its decomposition is also vastly more important than that of the former. Various factors such as seasonal changes, cultivation operations, application of different fertilisers and the nature of the vegetation determine the release of plant food from the organic reserves of the soil. (2) Plant growth is possible, at any rate in the early stages, in the absence of atmospheric carbon dioxide. Barley seedlings grown on manured soil show a definite gain in dry weight when air freed from carbon dioxide is drawn over them. No significant difference in weight could be noticed between seedlings grown in ordinary air and those over which CO_2-free air had been drawn, so that it would appear that the bulk of the carbon dioxide assimilated by the plants actually came through decomposition of organic matter in the soil. The following results would illustrate the above:—

Plant growth in the absence of atmospheric carbon dioxide.

Barley grown in	Average dry weight of seedling in mg.
Open air (Control) ..	$33 \cdot 3 \pm 0 \cdot 8$
Glass chambers (ordinary air drawn through)	$32 \cdot 7 \pm 1 \cdot 6$
Glass chamber (CO_2-free air drawn through) ..	$33 \cdot 2 \pm 3 \cdot 5$

In view of the evidence to suggest that the oxidation of the organic reserves of the soil is of considerable importance in plant nutrition, a number of experiments were carried out to study the effect of various treatments calculated to assist oxidation changes in the soil. The results showed that not only aeration but also treatments with different oxidising agents are greatly helpful in promoting plant growth. The following observations relating to a poor, gravelly soil containing 0·8 per cent. of organic matter will be of interest:—

Effect of treatment with oxidising agents on plant growth:—

Treatment	Average weight of barley seedling in mg.
Soil alone (Control) ..	$38 \cdot 2 \pm 4 \cdot 2$
,, + Ferric oxide (3 g.) ..	$51 \cdot 2 \pm 3 \cdot 1$
,, + Potassium permanganate (0·075g.)	$53 \cdot 6 \pm 1 \cdot 7$
,, + Hydrogen peroxide (1 c.c. of 3 per cent. soln.) ..	$49 \cdot 8 \pm 3 \cdot 1$

The foregoing observations are of much practical significance. Even the poorest soils of the world contain sufficient reserves of plant nutrients to meet the heaviest demands of crops for several decades, though under ordinary conditions, they are mostly unavailable. Judicious field practice will therefore have to include a system of utilising such reserves of the soil, together with the added manures, to the best advantage of the growing crop. At the same time, profuse decomposition should be avoided as it would result in rapid depletion of the organic reserves without adequate crop return. The oxidation changes should be hastened just at the time when crops require them most and, if possible, retarded at others.

The mechanism of the action of oxidising agents is still obscure. Whether those chemicals react directly with the organic matter forming carbon dioxide and other plant nutrients or merely bring about partial oxidation rendering the materials suitable for microbial action is still to be determined.

The ultimate processes leading to the conversion of organic manures into plant food are not yet fully understood. Particular mention should be made of the large quantities of organic as well as mineral matter stored in microbial cells and the subsequent release of which greatly adds to the fertility of soil. The mechanism of such transformations and the extent to which they are affected by different soil treatments are still obscure.

A further aspect of the problem which requires elucidation is the mechanism of oxidation of organic matter in swamp soils. Although it is now well established that the initial transformations attendant on the application of organic manures, particularly green manures, are of the nature of acid and gas fermentations, yet the subsequent changes leading to the conversion of these products into plant food are not yet fully understood. It is hoped that later researches will throw some light on the above and related problems.

A New Theory of Sun-Spots.

By H. P. Waran,

Department of Physics, Presidency College, Madras.

SUN-SPOTS, though a very long observed phenomenon, still defy satisfactory explanation. As a result of modern astrophysical research, especially with the spectroheliograph, the facts known about them are many and any new theory attempting to explain the origin and behaviour of sun-spots has to take note of all these facts.

There was a time, years ago, when the very simple idea that sun-spots arose as a result of a hollow in the sun caused by something of the nature of a volcanic eruption, held the ground; but why these spots never appeared at high latitudes in the sun, and why they are largely confined to the equatorial belt of the sun, could not be given a satisfactory explanation. When you add to it the experimental conclusion of a definitely observed periodicity for this solar activity, this simple explanation becomes almost impossible of acceptance. That the dark appearance of these spots is due to the cooler vapours prevailing in this locality and that the cooling is due to the expansion of the hot vapours from the interior that have risen to the surface is quite possible. But then there is the question why if the vapours are right from the interior at a very much higher temperature, they are not actually hotter than the surrounding surface. It may be answered by limiting the origin of sun-spots to within a shallow surface layer of the sun even as terrestrial volcanic phenomenon. Then no very high temperatures different from that of the surface layer are called for. Then the cooling by expansion might become the more predominant factor and the relative darkness of the spots does find an explanation.

The revolutionising discovery of definite rotations round the axis of sun-spots, made with Hale's spectro-heliograph led to the forecast of magnetic fields associated with these spots. This was brilliantly verified by the observation of Zeeman effect in these spots. It was further observed in this study that the spots generally occurred in pairs and that the succeeding spot or spots have, in general, a polarity opposite to that of the leading spot. Thus, any theory put forward now must explain these additional observations as well.

I have been entertaining an idea for the last few years that such polarised phenomenon in the sun can be explained only on the basis of corresponding polarised happenings. An explanation for this peculiar behaviour of sun-spots must be sought in the swarms of planetary or cometary bodies we know to be going round the sun. The assumption is that these fall into the sun giving rise to the spots and that these are bodies having, like planets, a rotation of their own about their axes. Such an assumption seems to explain almost all the observed peculiarities of sun-spots.

(*a*) *Observed Periodicity and Latitude Effect.*—The sun-spot activity has been resolved into a marked eleven-year period and there are indications of the presence of many other periods superposed on this generally accepted period. If we assume the existence of a planetary, cometary or meteoric swarm of this period, the cyclical nature of the sun-spot activity naturally follows. At perihelion passage, some of these bodies which are distributed along a stretch of the orbit may be sucked into the sun, the impact and superficial entry being almost tangential. The observed superposed periods can be explained either as due to these bodies distributed along the orbit or as due to a number of such swarms of different orbits with corresponding periods. That sun-spots occur only about the equatorial belt naturally follows from the above. The orbits must of necessity be distributed at small inclination to the equatorial plane of the sun—hence the comparative absence of high latitude spots, any progressive shift in latitude of the spots with the advance of the period being explained by the corresponding distribution of these bodies in their general orbit which is quite possible.

(*b*) *The Magnetic Peculiarities.*—The magnetic peculiarities, so difficult of explanation on any of the older theories, seem to follow readily from the fundamental assumption made above. The assumption of these planetary bodies naturally involves the further assumption that as planets they have rotations of their own round their own axis. Hence, if such a body were to fall into the sun, the consequences can be imagined

to be as follows. The body, spirally converging on to the sun, hits the surface almost tangentially at a small angle and its penetration into the sun might be only to a small depth. If at all it is massive, its total rise of temperature and loss by vaporisation might be only slight during its rush through the solar atmosphere. Hence its penetration into the sun is certain. The angular velocity of its own rotation about its axes is sure to impart a rotation to the region of the sun round the point of impact and this explains at once the observed axial magnetic field of every sun-spot. The partial vaporisation of the body and outrush of the vapours accompanied by expansion and cooling explains the darkness of the spot, and the spectral changes noticed in spots.

Since the entry of the body into the sun is far from normal, because of its high velocity in its orbit, it is sure to get out, a process in which it may be assisted by the centripetal force due to the rotation of the sun itself. If the intense heat explodes the body, the emergence becomes multiple instead of being single and it accounts for the trailing spots being often multiple instead of being single. It is interesting to note at this stage that the direction of rotation imparted to the solar surface at emergence (from our viewpoint) is opposite to that at entry, even though the body continues to rotate all the time in the same direction. Thus the leading spot being opposed in magnetic polarity to the trailing spot or spots finds a ready explanation on this hypothesis. That the trailing group of spots all of them have the same polarity naturally follows. That in a solar cycle the polarity of leading spots remains unchanged also follows. That spots usually occur in pairs also naturally follows if we assume the incident body to emerge out of the sun, probably to skim the surface again giving rise to another set of spots. Magnetic polarity observed even in localities showing no visible spots also follows, if we realise that some of these incident bodies may be too small to give rise to a spot of appreciable size on the surface of the sun. All the same they give rise to rotations on the solar surface and they are revealed to us as spots by this magnetic effect.

The only remaining aspect calling for an explanation arises from the observation that in succeeding 11-year solar cycles there seems to be a reversal of the magnetic polarity. Our observation and study of sunspots has not extended through a number of cycles to really justify such generalisations. But inasmuch as the indications are, as stated, we may examine to see how this fits in with our theory. All that one has to make is the further assumption that there are two sets of such planetary bodies going round the sun with a 22-year period with a phase difference of 11 years between them, the individual rotations in the two sets of bodies being in opposite directions.

What these bodies might be, if they are the shattered remnants of comets or planets, if they are the remnants of the arms of a spiral nebulæ whose nucleus is our sun are ideas that suggest themselves for further examination. The long period seems to suggest a cometary orbit of great eccentricity and one wonders if any evidence is available for the axial rotation of the comets. Possibly a cometary theory for the origin of sun-spots is not entirely a new idea. But the writer is not aware of any attempt to explain the magnetic polarities and peculiarities of sun-spots on the assumption of the planetary rotations of such cometary bodies. Hence this new theory of origin and behaviour of sun-spots is put forward for further examination by those engaged in the study of sun-spot phenomena.

Megalithic Work in Assam.

By Dr. J. H. Hutton, C.I.E., D.Sc., *Radnor.*

MEGALITHIC work in Assam is important not only as bearing on the cultural and racial relations between Assam and the adjoining regions, but also as bearing on the whole question of Indian pre-history, and of her cultural and racial connections with the Mediterranean and with Oceania.

Megalithic work in Assam has definite associations with the dead and with their *post mortem* future, and this probably applies also to the Megalithic work throughout India. At the same time such work is, at any rate in Assam, also definitely phallic in certain aspects. These two sides of the culture are interdependent and go together to constitute a fertility cult of the dead.

The souls of the dead are associated with crops and with life in general. The underlying principle is well illustrated by the Karen doctrine that the soul consists of some sort of life-matter emanating from the body so to speak, when the body dies, and entering the crops and so imparting life to them and thence in a recurrent cycle to beasts and men. This idea of life as a finite material substance limited in quantity is common in Assam and may be illustrated by the Lushei conception of it as rising from the body and falling to earth as it were dew. This conception is possibly connected with its association with water and with the remains of a dual fertility cult which conceives of the sky as male and fertilising a female earth. This material conception of the soul or life as a substance has also led to the practice of providing receptacles for it after the death of the body, in the shape of wooden statues or of stones, generally, but not always, in the form of rough stone monuments, sometimes phallic in shape. For some stone menhirs are definitely phallic, while others replace wooden emblems which are phallic. All have definite associations with the fertility value of the individual for whose life-matter they are provided, and generally with the fertilisation thereby of the community for which purpose the phallic shape of the monument may have a sympathetic magical value. (It may here be pointed out that the confusion between the magical value of the phallic emblem and the value of the statue as a receptacle for life-matter is assisted by the fact that both the phallus and the human body when reduced to the minimum of individual design are hardly distinguishable from one another. In any case the practice of erecting statues of the dead to house their life-matter impinges very closely on the magical phallic fertility cult.)

This cult of the life-matter of the dead appears in Assam in varying forms. The well-known monoliths at Dinapur are similar in design to the wooden emblems used at a fertility ceremony by the Angami Nagas, who, however, use simple menhirs differing merely in size to represent the two sexes, or to house their life-matter. On the other hand they are traditionally believed to occupy the site of an ancient market place or meeting place such as is associated with rude stone monoliths at Nartiang in the Jaintia Hills. Here, however, as in the stone monuments of the so-called Kachha Nagas, the female principle is represented by a flat stone dolmen while the male is again an upright menhir. It seems likely that this method of representing the male and female principles has been forced on the Syntengs by the nature of the material used, as they appear to have migrated from the North Cachar Hills, and to have left behind them their typical clan mortuaries with twin waterpools like those still associated in the Khasi and Jaintia Hills with the cult of the dead clan, but having huge phallic urns of sandstone (some still containing remnants of burnt bone) instead of the rectangular cists now used by the Khasis and Syntengs for that purpose in their present country in which only an unworkable gneiss is available for the construction of receptacles for the bones of the dead. Even in the north Cachar Hills sites, however, the use of a menhir and a dolmen (of the type for which Mr. Perry uses the term dissolith) is found by the side of the twin tanks which are still spoken of by the present inhabitants as the "dancing places" of their predecessors. The pre-historic mortuary urns of these sites are in some cases definitely female and in others definitely male in form, suggesting the stone cists still used by the Konyak Nagas which take the form of the sex of the individual whose skull is found within, the life-matter being accommodated immediately after death in a wooden statue pending the removal of the head from the corpse when putrefaction

has facilitated its detortion. Some other allied tribes, however, content themselves with a wooden statue of the dead with horns projecting from the head to receive and protect the skull of the deceased which is conceived as passing downwards from the skull into the figure below. Menhirs and dolmens, however, are found in the villages of these same tribes, though their precise significance has not yet been determined, and much resemble those put up by some Angami Nagas. The latter also erect memorial menhirs which rise from a stone platform which is trapezoid in form, one of the two parallel ends being always shorter than the other while the two sides are of equal length. It seems likely that this platform is so shaped to represent the female principle and the whole construction is analogous to the *lingam* and *sakti* of Hinduism.

It would seem that from being of individual value as a receptacle for life-matter, virtue has attached to the use of great stones in general, particularly in association with the dead or with water. Thus, they have been used in the erection of forts by the Angami Nagas, these forts usually occupying sites under which the founders of the village have been buried. No doubt the life-matter of the deceased gives strength and perpetuity to the building. Megalithic bridges also occur in Assam, and monoliths are very frequently erected on the banks of rivers, particularly at bridge-heads. Megalithic temples and paved approach roads are found associated with fertility cults, and in two such cases at any rate temples of this kind have been associated with human sacrifice or fertility cults; it may be observed that Assam has been a stronghold of Tantric worship.

A number of parallel instances of this belief in a material life-substance as noticed in other parts of India will be found in chapter eleven of the *Report on the Census of India*, 1933. It will be enough here to give a brief reference to the brass images made by Kolis, who collect them till they have an inconvenient number and then consign them to a stream; to the metal image of the dead, placed in miniature dolmens and periodically worshipped, of a tribe in Travancore in Southern India; to the Munda and Oraon practices of putting up stones in honour of the dead, such stones being in the case of Mundas collected in clan or tribal groups. In some cases there seems to be a connection between stone monuments and pot burial, as the Konyak Nagas who use stone cists have an alternative method of burying the head of the deceased in a pot the mouth of which is covered by a second pot or bowl inverted. The use of wooden life-receptacles has a close parallel in the Nicobarese practice of interring the bones in a wooden statue with the skull as a head. The west coast structures in the form of stone chambers with a circular cap, mushroom dolmens they might be called, have no close parallel in Assam but it is possibly significant that both the chessmen monoliths at Dinapur and the stone urns of N. Cachar have their domes incised with cross lines like the caps of the mushroom dolmens, while the Khasi monoliths sometimes have a round stone superimposed. It may be added that there was a close parallel to Dinapur chessmen to be found in one or two of the carved pillars at Lohazdagga in Chota Nagpur. The holed dolmens of Southern India have no directly corresponding parallel in Assam, but it is possible that the reason for the existence of the hole is to be inferred from the Kuki custom of inserting a bamboo into the grave (sometimes stone lined) to provide for the ingress and egress of the soul, a custom which appears again, also in association with monolithic work, in Madagascar. There is, however, no known parallel in Assam to the stone cist burial described from Jewurgi in Central India which is apparently not dissimilar from some South Russian burials possibly of some proto-nordic association. Nor is there anything in Assam that corresponds to the baked clay cist and capstone of the Hyderabad burials, though parallels can be found to the ring of stone that surmounts the grave and the occasional menhir of the Hyderabad burial areas. There is no precise parallel to the circle of menhirs of N. India in which marriage processions stop to dance, though circles of flat stones are put up to commemorate deceased persons who have been particularly rich and prosperous and have therefore high fertility value, and at Gwilong or Togwema in the Manipur State (for instance) dancing, swimming and wrestling take place inside a group of menhirs in honour of the dead at one of the agricultural festivals of the year, and in Angami villages it is common for the "pullers" of phallic wooden to stop and dance in what are known as "pools", open spaces of the village often associated with stone monuments.

The theory is advanced that all these customs are associated with a conception of life as a material and finite substance, a conception which leads logically to head hunting, cannibalism and human sacrifice as means of obtaining life-matter. It is well known that primitive languages are exceedingly poor in abstract terms; abstractions are therefore almost certainly foreign to primitive thought. It is suggested that the first conception of life is likely to have arisen from an attempt to comprehend death and the obvious but not easily explicable difference between a living man and a corpse. By a savage, unable to grasp any conceptions but those of concrete and finite matter, life would naturally be regarded as a finite material substance separable from the body and hence a wide field of speculation leading on the one hand to the practice of human sacrifice and other such means of obtaining life-matter, and on the other to the Vedantic philosophy which regards the body as a mere shell to house the soul, and only one of many such. It is suggested that this philosophy of life originates in the pre-Aryan civilisation of India, probably of Mediterranean or Syrian origin.

Letters to the Editor.

Hydro-Electric Schemes in India.

I WAS very much interested to read a letter by Dr. H. E. Watson on Hydro-Electric Schemes in India, in the August issue of the *Current Science*.

In general, the note appears to have been based on certain illusory defects. But, however, in the following brief note a few explanations have been given which will show that the adoption of 25 cycle frequency by the Mysore Government is not handicapping them as pointed out. In fact, it will be clear that it is no handicap at all.

The chief points raised in the note referred to are:—

(1) Defects regarding linking Mysore in future with the rest of India in case a grid system develops.

(2) The handicap which Mysore will be having in case railway electrification is taken up.

(3) Effect of 25 cycle lighting on the eyes of the villagers.

1. No doubt most parts of India are adopting in general 50 cycle system for the power generation and distribution system. The existing 25 cycle system in Mysore is due to the fact that the scheme was started long before any other scheme in India had been taken up. But this does not isolate us from the rest of India. There is machinery available to link the 25 cycle system with 50 cycle system if we want to do so and the object of such a linking in general is to utilise the spare power available during off peak-loads from one station to other stations where the load demand is more and the station by itself is incapable of meeting it. In the case of Mysore, such a spare power during off peak-load hours to the extent of about 25 per cent of its capacity can be made available for other systems when the grid system is adopted by such a machinery. The cost of such a machinery will be about one per cent of the cost now involved in changing the whole system to 50 cycles. In view of the above flexibility available it is but natural that it would be wasting money if an attempt is made to change the equipment so that the general supply becomes 50 cycles.

The next important point which prevents any such scheme being adopted is the point of view of the consumers who have purchased motors and other machinery suitable for 25 cycles whose equipments will have to be replaced at departmental cost if such a frequency change is adopted and the cost of such an arrangement obviously is prohibitive.

2. The difficulties, enumerated by the writer, that Mysore would be experiencing in case A. C. electrification of railways is adopted are not real. It is an established fact that the use of direct current for traction purposes has many distinct advantages and many of the electrifications in India have adopted D. C. system. From a perusal of the recent advancement made in the design and satisfactory operation of mercury arc rectifiers it will be seen that the recent experiment on A. C. electrification, which claims almost equal flexibility with the D.C. electrification, is further set back by the advantage gained in the natural characteristics of the rectifiers which, probably, will permanently claim superiority for D. C. electrification over A. C.

electrification of railways and thus the question of A. C. electrification may permanently be postponed.

From the above it can be seen that if Mysore intends electrifying its railways it will have to adopt D.C. system and when D.C. system is adopted no question of frequency arises and Mysore will not be handicapped in any way.

3. The question of the effect of low frequency illumination on the eyes is a point which I do not want to answer as it is beyond my sphere of activity. But the following short explanation will establish the fact that the rural areas have gained to a large extent at a small sacrifice if the 25 cycle lighting is considered harmful at all. The amenities of life resulting from the electrification of a town were only within the reach of the people living in Bangalore and Mysore. It was the desire of the present Dewan to see that these amenities were made available to the ryots in villages and the people in other head-quarters, as they form a larger portion of the population of the State. But there were two difficulties to be surmounted:—

(*a*) The ryots, as a rule, were poor and could not afford to pay for the amenities at the same rate as the people in Mysore and Bangalore could afford to do and the Municipalities were agreeable to get their town electrified provided it did not cost them very much more than what it would cost them at present to maintain kerosene lamps. This, of course, is due to their poor condition.

(*b*) On the other hand, Government could not undertake such works and invest large capital where the return was very low.

Thus, the department was called upon to find a solution for the two difficulties mentioned, and on careful planning it was found that if the same distribution mains are adopted to carry power load during day and lighting load during night the capital cost involved in the electrification of a town would be considerably reduced, and it was also found out that if the capital cost was reduced by this means the Municipalities were capable of giving a revenue which would be reasonable on the part of Government to invest the capital involved. Thus, it was adopted and 25 cycle lighting had to be resorted to. But this point in the design has been kept in view that when the lighting load improves in each of the sub-sections the department will have to install frequency changer sets converting the existing lighting system to 60 cycles and maintain the power supply at the 25 cycle system. This will not involve any additional expenditure on the part of consumers themselves and the increased revenue in lighting installations will justify the capital expenditure involved in changing the frequency from 25 to 60 cycles which is being done at present in Mysore and Bangalore.

It is hoped that the few points noted above will convince the people concerned that Mysore is not going to be an island as far as the electrification scheme is concerned as it may appear to be.

MOHAMED HAYATH.

Bangalore,
September 14, 1933.

A Triploid Plant in Rice (*Oryza sativa*).

IN the fourth generation of a cross between two varieties of rice, an abnormal plant was noticed characterised by marked sterility with only five seeds setting, out of nearly 800 spikelets. This plant on cytological examination proved to be a *triploid*. This is the second instance of the occurrence of triploidy in rice, the only other recorded case being in Japan where Nakamori (1932)[1] observed a triploid plant in the eighth generation of a cross between two varieties and determined its nature by noting 36 chromosomes in root tips.

Aceto-carmine smears were employed to study the meiosis of this plant. At Diakinesis, 12 trivalents are usually observed, though occasionally cells are met with, where the third member of one or more groups appear unassociated with its homologues (Fig. 1). At metaphase (Fig. 2) normally the 12 groups arrange themselves on the equator and very early in the anaphase the members of the trivalent groups disjoin into distinct units and assort apparently at random to the poles. In the material so far examined the distribution of the chromosomes to the poles was found to be either 18 and 18 or 17 and 19. Frequently univalents are seen to split (Figs. 3 and 4) and the split halves either move to the opposite poles or to the same pole. The second division is

[1] Nakamori, E., *Plant Breeding Abstracts*, **3**, No. 3, 1932, *Imp. Bur. Plant Genetics.*

more regular and the resulting microspores are of varying sizes, most of which degenerate into empty pollen grains. It is probable

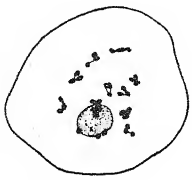

FIG 1

FIG 2

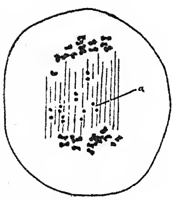

FIG 3

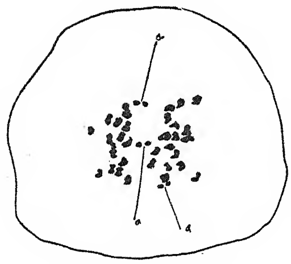

FIG 4

1. Diakinesis in the triploid (× 333)
2. Early metaphase triploid (× 333)
3. Late anaphase triploid (× 333)
4. Early anaphase triploid (× 500)

Note the splitting univalents (*a*) in (3) and (4).

that this plant arose by the fusion of a diploid and a haploid gamete. The investigation of this point and further detailed study of this plant are in progress and will form the subject of a separate article.

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Coimbatore,
October 14, 1933.

A Note on Fossil Angiospermous Fruits from the Deccan Intertrappean Beds of Central Provinces.

DURING the last four years the author has collected a large number of silicified angiospermous plants[1] from the Intertrappean rocks of Mohgaon Kalan, in Chhindwara District, C.P. This collection includes several specimens of *Nipadites*, trilocular and multilocular fruits.

Though Hislop[2] appears to have collected during the sixties of the last century, some globular multilocular and two trilocular fruits from similar beds in Central Provinces, description of none of these has been recorded. Moreover, there is no mention of the occurrence of *Nipadites* in his collection. The present discovery is, therefore, significant in being probably the first of its kind in India.

The present note is intended to give a brief description of the various fruit types from the Mohgaon locality. The very limited knowledge of systematic Botany has so far confronted the author in arriving at the true affinities of these angiospermous fruits and he would, therefore, through this note, be glad to invite suggestions from the systematic Botanists.

The specimens of *Nipadites* fall into two distinct groups necessitating the creation of two new species. *Nipadites compressus* Sp. nov.—These are drupes of medium size with a planoconvex or lenticular cross-section, and with 3—4 longitudinal ridges converging on apical side into an umbo and terminating on the other into a flat base. Pericarp is usually thin with smooth epicarp, finely fibrous mesocarp, and a hard endocarp. Seed is very large, only slightly smaller than the fruit and extends from base to apex reproducing the irregularities of the surface (Fig. 1).

Size.—4·7 to 8·5 cm. long, 4·0 to 4·5 cm. broad, thickest 2·0 to 2·3 cm. near the apex thinning gradually towards the base.

Remarks.—Resembles much with *Nipadites lanceolatus* Bowerbank. Represented by at least 3 complete well-preserved specimens.

Nipadites hindi. Sp. nov.—This is represented by a single, exceptionally well-preserved complete specimen. It is a drupe of moderate size (5·6 cm. long, 4·2×3 cm. in cross-section near the apex), obovate or pyramidal in shape, thickest near the apex and narrowing towards the base. The cross-section is four-sided with no two sides equal or parallel. On the apical surface a small but prominent eccentric umbo sends out four ridges to the four corners, running to and converging towards a narrow base which carries a broad round stalk-cavity. The epicarp is thin and smooth, mesocarp of

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[1] Rode, K. P., "Petrified Palms from the Deccan Intertrappean Beds," *Q. J. G. M. M. Soc. Ind.*, **5,** No. 2, p. 75, 1933.

[2] Hislop, "Remarks on the Geology of Nagpur," *Jour. Bom. Br. Roy. As. Soc.*, **6,** pp. 194-204, 1861.

variable thickness is compactly fibrous while the endocarp is thin and hard. The seed is 3·5 cm. long, nearly oval or ellipsoidal in cross-section (2·2×2·8 cm.); it has large cavity partly filled with crystalline silica while its outer surface is smooth or finely reticulate (Fig. 2).

The Fossil Trilocular Fruits.—There are about a dozen specimens of trilocular fruits triangular in cross-section and with

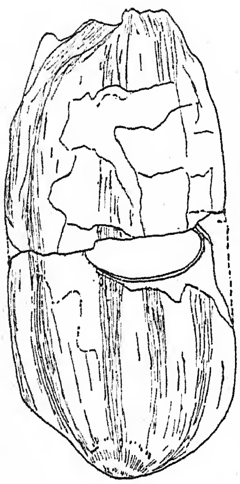


FIG. 1.

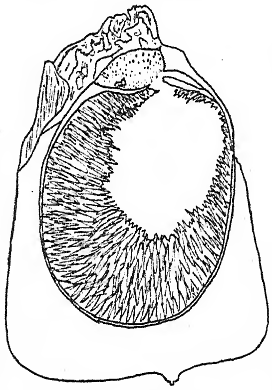


FIG. 2.

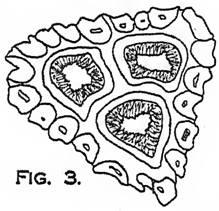


FIG. 3.

a mango-like outline in longitudinal section. The fruit contains three large elongated seeds placed vertically in three fertile loculi and separated by moderately thick septa continuous with the central column and the inner layer of the pericarp. One of the three seeds is often abortive while the well-developed seeds are more than twice as long as broad and vary in thickness as well as in outline. They are commonly hollow showing a probable albuminous nature while an outwardly directed beak-like prolongation might indicate parietal placentation which is otherwise obscure. The fruit wall is very characteristic and is traversed by numerous ribs and furrows associated with U-shaped fluid canals running the whole length of the fruit. The whole fruit was contained in a cuplike receptacle carrying the stalk of the fruit while its ventral surface reproduced the furrowed appearance of the fruit surface. There is no clear indication of the true dehiscence of the fruit.

In size the fruit is 4·0 to 4·5 cm. long, 2·5 to 3 cm. broad and nearly as much thick in the middle tapering more towards the apex than towards the base.

The fruit shows several characters common to Euphorbiaceæ and has therefore been provisionally placed in a new genus *Tricoccites* and specifically named as *T. trigonum*.

Multilocular Fossil Fruits.—There are again a number of small globular many-seeded fruits which form a group by themselves. They are nearly spherical in shape, about 2 cm. in diameter, and usually with slight depressions at the basal and apical ends. The surface is glabrous and is traversed by eight longitudinal depressions converging at the two ends. Each of the eight loculi contains two rows of about ten small elongated seeds each, with axile placentation placed in a roughly radiating manner on a stout columnar central axis. The fruit is a capsule with a loculicidal dehiscence.

The fruit shows great resemblance with *cucumites* Bowerbank in external appearance but since the internal seed arrangement in this genus is not well known it is difficult to rely on external resemblance alone.

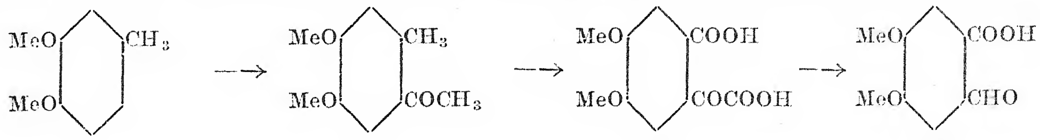
The detailed study of these fruit types along with the discussion of their affinities will be published in due course but in the meanwhile the author will be very thankful for all suggestions helpful in arriving at the true affinities of these fruits.

K. P. RODE.

Department of Geology,
Benares Hindu University,
October 25, 1933.

A New General Method for Synthesis of Substituted O-aldehydo Carboxylic Acids: A Preliminary Note.

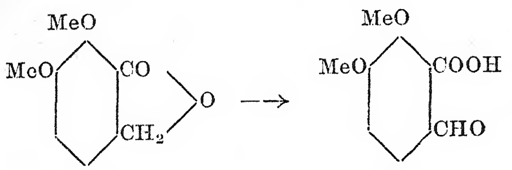
THERE are very few really good methods available to-day for the synthesis of substituted O-aldehydo acids. Thus the majority of the mono-methoxy and dimethoxy O-aldehydo acids have either still to be synthesised or have been synthesised by methods which are either not of general application or are too tedious. At the time when these researches were started, only *m*-opianic acid, and opianic acid had been synthesised. The synthesis of *m*-opianic acid was first accomplished by Perkin and Fargher (*J.C.S.*, **119**, 1724, 1921) in accordance with the scheme:—



(I) (II) (III) (IV)

Unfortunately this excellent synthesis cannot be generally applied; firstly, because it is very difficult to introduce the acetyl group in the required position and, secondly, because the oxidation of substances of the type II, gives rise to a variety of different products which are often difficult to separate. Applications of Reimer-Tiemann reaction also cannot be used as a general method for the synthesis of O-aldehydo acids (compare Perkin and Stoyle, *J.C.S.*, **123**, 3172, 1923).

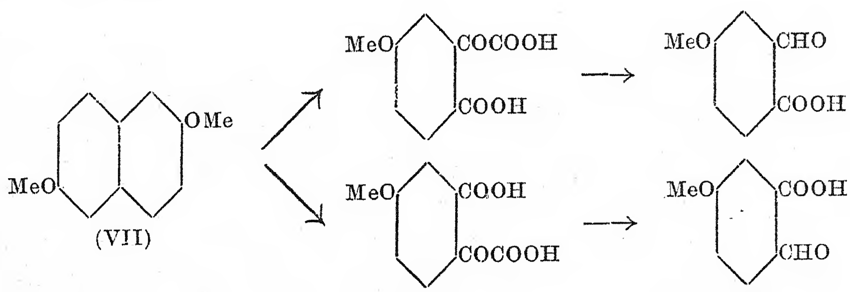
The only other method which has been tried successfully is the method of the oxidation of Phthalides. Thus opianic acid (VI) has been obtained by the oxidation of meconine.



(V) (VI)

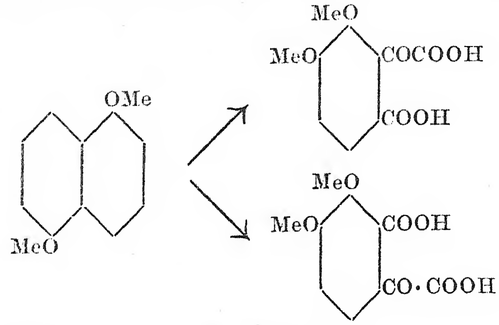
This method is also of only limited application as is shown by the failure of attempts at direct oxidation of ψ meconine (Solomon Ber., **20**, 888, 1887; Edward, Perkin and Stoyle, *J.C.S.*, **127**, 196, 1925; Chakravarti, *J. Indian Chem. Soc.*, **6**, 208, 1929) of 3:4-methoxylene-dioxy-phthalide (Perkin and Trikofus, *J.C.S.*, **129**, 2931, 1926) of 4:5 methylene-dioxy-phthalide (Stevens and Robertson, *J. Chem. Soc.*, **131**, 2791, 1927) and of 4-methoxy-phthalide (Chakravarti and Perkin, *J.C.S.*, **197**, 1929). The present author tried a number of devices to get over this difficulty in 1929 (*J. Indian Chem. Soc.*, **6**, 209, 1929). In the case of ψ meconine, more recently still, Robinson and Greenwood succeeded in converting it into ψ opianic acid by first converting ψ meconine into β-ψ-gnoscopine and then oxidising the β-ψ-gnoscopine (*J.C.S.*, 1371, 1932).

The present author tried to devise a number of general methods for synthesising methoxy-O-aldehydo acids in 1928. As a result of this and subsequent work two general methods have been developed, one starting from the hydrindones, and the other from the substituted derivatives of naphthalene. In the latter method a symmetrically disubstituted or symmetrically tetra-substituted naphthalene derivatives are oxidised with alkaline permanganate under special conditions. To take an example, when 2:6 dimethoxy naphthalene (VII) is oxidised, 5-methoxy-phthalonic acid (VIII) is first formed which is readily converted into 5-methoxy phthalaldehydic acid (IX).



(VII) (VIII) (IX)

The idea behind the synthesis is that whichever benzene ring is ruptured during oxidation, a methoxy-phthalonic acid must be formed under suitable conditions. A number of such syntheses has been effected and an account of the synthesis of all the methoxy-phthalaldehydic acids and the three opianic acids by this method, *viz.*,



is reserved for a future communication.

SATYENDRA NATH CHAKRAVARTI.

Department of Chemistry,
Annamalai University,
Annamalainagar, South India.
October 24, 1933.

The Young's Moduli of Marble at Low Stresses.

PROF. DALY'S researches on the constitution of the earth's crust are well known. He was kind enough to send us a reprint of a paper[1] in which he has discussed the reasons for believing that the seismically effective elastic moduli of the invisible shells of the earth's crust should be systematically greater than those of the same kinds of rocks when tested by any high pressure method in the laboratory. The earthquake waves, according to him, running through a granite terrace, travel at least 20 per cent. faster than they should, if the elastic moduli (bulk modulus and rigidity modulus) were those measured at high pressures.

In spite of the above reasons, many geophysicists are assuming identity for the moduli independently of the stresses under which they are measured.

It thus seems very necessary in order to draw correct inferences as to the materials forming the shells of the earth's crust, that experiments at very low stresses such as are set up in earthquakes, be carefully performed in the laboratory.

The object of this note is to give the results of our experiments on a thin slab of marble when its Young's moduli were determined at very low stresses by the Flexure Method, using two mirrors, one at each end of the slab and a telescope and a scale to read the deflection produced when stresses were applied. The sensibility of the arrangement was such that a stress of $0 \cdot 3 \times 10^6$ dynes/cm^2. produced a deflection of 1 mm. on the scale. The actual dimensions of the slab were: length$=45 \cdot 60$ cms.; breadth$=7 \cdot 80$ cms.; thickness$=0 \cdot 55$ cms. The density of the marble was $2 \cdot 724$.

In order to test the suitability of the experimental arrangements adopted, experiments on several metals, such as, iron, steel, brass, etc., were first performed. The results in these cases agreed fairly well with those given by D. K. Fromen,[2] whose curves show that ordinarily in the regions of low stresses of the order of 10^6 dynes/cm^2. for metals, the Young's modulus increases with increasing stress up to a certain limit and then decreases tending to assume a more or less constant value at higher stresses.

When, however, marble was tried, its behaviour departed completely from that of the metals. While with metals there was a rise followed by a fall in the value of the Young's modulus with increasing stress, in the case of marble this elastic constant continually fell, probably reaching a constant value asymptotically at a considerable value of the stress.

The accompanying curves show the variation of Young's modulus of marble with stress. Four different sets of observations were taken, each with increasing and decreasing stresses. Curve A fits the observational points of the 1st and the 2nd sets and curve B those of the 3rd and the 4th. There was a sudden change in the Young's modulus of the marble at the end of the 2nd set of observations, probably due to its Latent Splitting.[3] The 4th set of observations closely followed the observations of the 3rd set. In fact the curve B is practically curve A displaced by a definite amount.

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[1] *Bulletin of the Seismological Society of America*, **20**, No. 2, 1930.

[2] *Phy. Rev.*, **35**, 264, 1930.

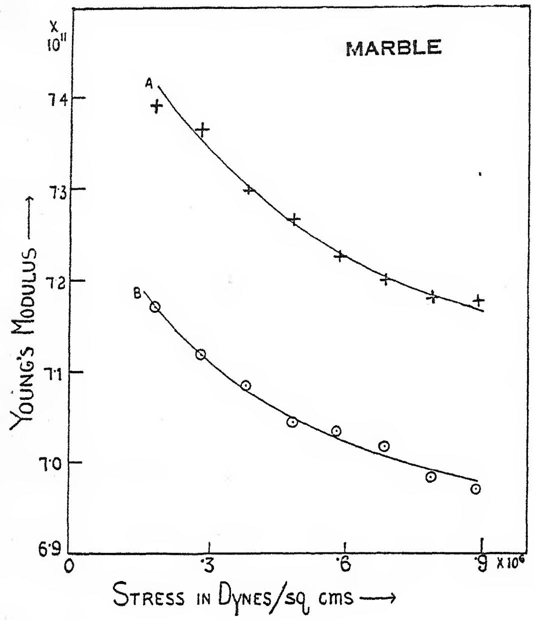
[3] *Nature*, **17**, Jan. 17, 1931; *Bulletin of the Patna S.C. Phil. Society*, **3**, Jan. 1933.

These curves can be fairly accurately expressed by the following two equations:—

$(E-6 \cdot 92 \times 10^{11})(S+0 \cdot 509 \times 10^{6}) = 0 \cdot 338 \times 10^{17}$ ..(A)

$(E-6 \cdot 84 \times 10^{11})(S+0 \cdot 327 \times 10^{6}) = 0 \cdot 167 \times 10^{17}$ ..(B)

where E represents the Young's modulus and S the stress.



In equation A if we put $S=\infty$, we get $E=6 \cdot 92 \times 10^{11}$ and if we put $S=0$, we get $E=7 \cdot 59 \times 10^{11}$. Therefore the % increase in E in the region of zero stress is 9·68.

Similarly, from equation B the % increase in E in the region of zero stress, comes out to be 7·46. The mean value of these % increases is 8·57.

The above estimate of the % increase in E is based on extrapolation—not a very desirable procedure, but there can be no doubt that over the regions of stress actually covered in the experiments, there is a regular increase of E with decreasing stress as suggested by Prof. Daly. It is further possible, that over the unobserved regions of low stress the Young's modulus of marble might increase faster than in our experiments, leading in the end to that % increase, which Prof. Daly suggests.

We could not pursue the experiments with other rocks as they were not available to us. It was nevertheless thought that the results obtained with marble were sufficiently instructive and that they might prove of interest to geophysicists specially.

K. PROSAD.
S. SHARAN.

Department of Physics,
Patna Science College,
October 26, 1933.

On Certain Helminth Parasites from "Chandrabora"—Russell's Viper (*Vipera russellii*) obtained from the Nizam's Dominions.

THREE distinct types of nematode parasites have been obtained from two nearly full-grown specimens of Russell's vipers examined, each nearly 116 cms. in length (without the tail, which is nearly 23 cms.), and out of which one was a ♂ that had devoured two field-mice, possibly *Mus buduga*, and the other was a ♀. The bulk of the parasites were little worms, about 2 cms. in length, slightly pinkish in colour during life, and they were *Kalicephalus willeyi* v. Linstow. A few of these worms were found inside the œsophagus, some in the stomach and many in the intestines of the vipers. Amongst the whole lot the other kinds of parasites included two examples of *Physaloptera* sp. (allied to *P. paradoxa* v. Linst.) and three females of *Rictularia* sp. (allied to *R. fallax* Jägerskiold—a parasite of rodents). *Kalicephalus*, and probably *Physaloptera*, would be normal parasites of the viper, and possibly the former may also be found in other Indian snakes. Dr. H. A. Baylis of the British Museum in a correspondence writes to us that *Rictularia*, however, is almost certainly a "pseudo-parasite" derived from animal swallowed as a prey, and the infection of these vipers with this worm is a likely consequence evidently due to the rodent-eating habit of the snakes. It may be remarked that Russell's viper is a wild feeder, preying upon fishes (less occasionally), frogs and toads, lizards, sometimes also devouring snakes (this being at least known in captivity), such as the common grass snake (*Tropidonotus stolatus*) and the young rat snake (*Zamenis mucosus*), besides small birds and rodents (rats and mice). He is of further opinion that *Rictularia* is not a genuine parasite of reptiles.

At this stage certain interesting questions arise: firstly, what is the mechanism of immunity of these worms harbouring

inside the alimentary canals of such deadly venomous snakes, and, secondly, how and where does the infection come from? In reply Dr. Baylis says, "... it seems to me a slight extension of the problem, which all internal parasites must solve, of withstanding the action of digestive fluids of the host. It is generally assumed, I believe, that worms solve this problem by continually producing some secretion which neutralises the digestive juices in their immediate vicinity. It is certainly a fact that if the worms die they lose their power of resistance and are soon digested. If this is true, then it seems to me possible that worms which live in venomous snakes may have the power of resisting the poison in the same way. But there is another aspect of this matter. I believe it has been found that the venom of snakes, however deadly when injected into blood or tissues, may be quite harmless when taken into the alimentary canal. In this case, it may also be quite harmless to an uninjured animal bathed in a dilute solution of it. Again, the poison may, by the time it reaches the parasites, have been so altered chemically as to have lost all its properties."

"With regard to the source of infection with these worms," he states, "*Kalicephalus* probably has a direct life-history, and infection would take place by accidental swallowing of eggs or larvæ (snakes swallow a good deal of dirt with their food). I do not think anything is known of the life-history of *Kalicephalus*, however, and it is just possible that, as in the case of some other Strongyloidea, the larvæ might be able to enter through the skin of the host. *Physaloptera* again we know nothing about from this point of view, but it belongs to a group (Spiruroidea) which requires intermediate hosts. From analogy one would expect to find its larval stages in insects or other arthropoids, and quite probably these would become re-encysted in vertebrates which preyed on the first host. This does happen with a number of Spiruroidea, so that carnivorous final hosts get infected when they in turn prey on smaller vertebrates."

We consider that very important and interesting results are expected to come out, if someone works out systematically the life-histories of the ophidian parasites of our country for which there is such a vast field, and we shall be very grateful if some fresh light is thrown on this problem, and at the same time we would be very pleased to have any further useful suggestions that would be an addition to our knowledge from those that are actually engaged in doing special work on the nematodes.

In conclusion, we take this opportunity of offering our best thanks to Dr. Baylis for kindly identifying the worms as well as for his most valuable suggestions. We are also very grateful to Moulvi Abdul Haq Saheb of our University for the gift of the fine specimen of the ♂ viper.

M. RAHIMULLAH.
B. K. DAS.

Department of Biology,
Osmania University College,
Hyderabad (Deccan),
November 1933.

Polarisation of the Fluorescent Band.

It is well known that when a viscous solution of a dyestuff is excited to fluorescence, the emitted light is found to be partially polarised. Various experiments have been done from time to time in the hope of determining whether the polarisation is the same throughout the fluorescent band. Weigert[1] found the polarisation greatest at the red end of the fluorescent band. Wawilow and Lewschin[2] working with filters to separate different spectral regions, found the polarisation practically same throughout the band. This result was confirmed by Wawilow.[3] With aesculin in sugar and gelatine solution Pringsheim and Wawilow[4] found the polarisation greatest at the short wave side of the band. Merrit[5] confirmed the observations of Wawilow and Lewschin in a recent communication.

In view of the contradictory nature of the previous experiments, a detailed investigation was undertaken by us. The experiment was performed with a all-glass spectrograph which had been calibrated for its polarisation by the well-known method.[6] The light from a monochromator after being polarised was allowed to be incident on the fluorescent solution. The transverse fluorescent radiations were focussed with a lens of long focal length on the slit of the spectrograph. By using a suitably oriented nicol in front

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[1] *Phy. Zeit.*, **23,** 232, 1922.
[2] *Zeit. Phy.*, **16**, 135, 1923.
[3] *Zeit. Phy.*, **32,** 721, 1925.
[4] *Zeit. Phy.*, **37,** 705, 1926.
[5] *Phy. Rev.*, **36,** 1386, 1930.
[6] *Ind. J. Phy.*, **6,** 193, 1931.

of the slit and a Hertmann's diaphragm, the two principal components of the fluorescent radiations can be spectrographed side by side in juxtaposition; the times of exposures are suitably adjusted for equalising the two components as they appear in the spectrograms. A glance on the spectrogram shows that the two components are equally intense throughout the spectral region, showing that the polarisation is the same for the different regions inside the fluorescent band.

At first we investigated a number of dyestuffs in glycerine and gelatine and found the polarisation same throughout the band. Recently we have investigated a number of simple organic compounds—sodium salicylate, ortho benzoic acid, β-naphthylamine in glycerine solutions and found the polarisation same throughout the fluorescent band.

S. M. MITRA.

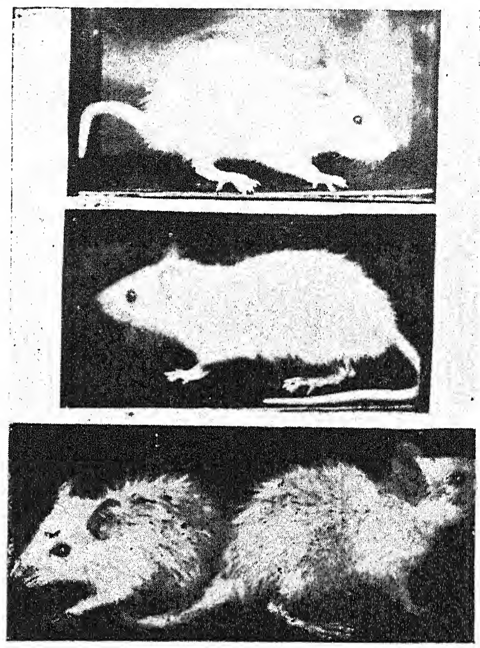
Physics Laboratory,
Dacca University,
November 2, 1933.

Effect of Cooking or Storing Food in Metallic Vessels.

THE increasing popularity of the use of metallic vessels, particularly in South India, for cooking and storing articles of food has now led to serious problem, which requires careful investigation. Some of the food preparations like *Rasam* or pickles are rich in salts and highly acid (as compared with similar preparations in most parts of the world) and are being cooked or stored in aluminium, lead, brass (tinned or otherwise) or bronze vessels, so that quite considerable quantities of the corresponding metals pass into solution and are thus consumed. The effect of such metallic contamination may not be immediately felt, or perhaps, even in a single generation, but their ultimate effect will have to be carefully considered in the interest of the future generations. The present investigation was undertaken with the object of throwing some light on the above and related problems. The following observations may be of interest:—

Tinned brass vessels are extensively used in Southern India for preparing acid foodstuffs like *Rasam* and *Sambar*. The following figures for representative specimens of *Rasam* (clear soup) from a hotel will speak for themselves: 5·2 parts per million of tin; 1·0 parts of lead; 4·6 parts of aluminium; 12·0 parts of iron and 3·6 parts of copper.

Young rats, weighing 40–45 grms. maintained on a diet of rice and *Rasam* prepared in newly tinned brass vessel with supplement of Vitamin A and B declined and



Top.—Rat on normal diet (Rasam and Rice).

Middle.—Rat on the same diet cooked in aluminium vessel.

Bottom.—Rats on the same diet cooked in brass vessel tinned inside.

died in the course of a month. Similar animals fed with the same diet prepared in aluminium vessel made slow growth in the beginning but developed normally at a later stage.

Fairly grown-up rats weighing 75–80 grms. kept on the same diet prepared in tinned brass vessel did not die but their growth rates were much lower than those of similar animals fed with diet prepared in aluminium vessel.

Lactic fermented milk kept in aluminium vessel for 18 hours had an aluminium content of 11·12 parts per million while that prepared in glass vessel contained only 0·45 parts per million. Rats maintained on curd from 20 c.c. of milk prepared in aluminium vessel supplemented with wheat *chappati* had normal growth, kept up healthy appearance and grew equally well as those getting the same quantity of curd from glass vessel.

The practical significance of the above and related observations is under investigation.

The researches have also been extended to the study of the effects of cooking or storing food in different other types of metallic vessels.

N. C. DATTA.

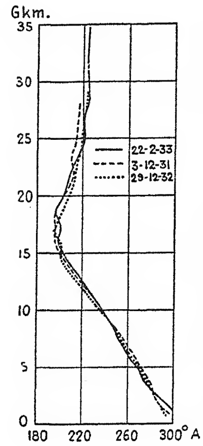
Department of Biochemistry,
Indian Institute of Science,
Bangalore,
November 6, 1933.

Some Exceptionally High-Sounding Balloon Ascents at Poona and Temperatures in the Stratosphere over the Tropics.

DIRECT observations of temperature in the upper atmosphere above 25 km. are very scanty. From an analysis of temperatures obtained from sounding balloons in different parts of the world, it is known that at a height of about 25 km., temperature all over the earth is more or less uniform being about $-55°C$. Experiments on the reflection of explosive sounds from the upper atmosphere which have been carried out in recent years in Europe have led to the conclusion that temperature again rises to that near the ground at a height of about 40 km.

Special efforts at increasing the height reached by sounding balloons have been made by A. Wigand[1] of the Deutsche Seewarte, Hamburg, who has recorded five ascents which went above 25 km., the greatest height reached being 35·9 km. Wigand found that there was only a very small increase of temperature between 25 km. and 35 km., the value at the highest point being near $-46°C$.

The accompanying figure which gives the height-temperature curves obtained from three ascents made at Poona in 1931-33 shows that in the tropical stratosphere, the temperature goes on increasing with height up to about 30 gkm.[2] and that even at 34 gkm., there is no evidence of any large rise of temperature. All the ascents were made within one hour before sunset so that the top part of the records would have been traced after sunset and would not have been affected by insolation. The temperature at the highest point was $-49°C$. No experiments have been made in the tropics on the reflection of sound waves from the stratosphere; but if it is assumed that the height of reflection is about the same as in temperate latitudes, the rate of rise of temperature should be very high immediately below the reflecting layer.



In a recent communication to *Nature*[3] Messrs. F. W. P. Götz, G. M. B. Dobson and A.R. Meetham have stated that observations at Arosa in Switzerland on the spectrum of the light received from the clear, blue zenith sky as the sun is rising or setting show that the average height of ozone there is about 20 km. which is much lower than the previously estimated heights (40-50 km). This conclusion gives support to the view[4] that the persistent rise of temperature between 18 and 25 km. in the tropical stratosphere is due to the presence of ozone. Attention may also be drawn to the fact that while in temperate latitudes, the temperature of the tropopause increases when its height lowers and *vice versa*, the height of the tropopause in the tropics does not show any tendency to rise above 17-18 km. in spite of large variations of temperature.[5]

The sounding balloons used in the above flights were made of 'Vulpro' tissue,[6] at the Upper Air Observatory, Agra.

K. R. RAMANATHAN.

The Meteorological Office,
Poona,
November 7, 1933.

Vertebral Centra of *Typhlops braminus*.

MOOKERJEE in his note 'On the Peculiar Apertures in the Vertebral Centra of *Typhlops braminus*'[7] states that he 'could

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[1] A. Wigand, *Beitr. zur. Phys. der fr. Atmosphare*, **17**, p. 286, 1931.

[2] 1 gkm. at the latitude of Poona=1.021 km.

[3] F. W. P. Götz, G. M. B. Dobson and A. R. Meetham, *Nature*, Aug. 19, p. 281, 1933.

[4] K. R. Ramanathan, *Nature*, June 1, p. 834, 1929.

[5] *Memoirs*, Indian Meteorological Department, **25**, Part V, fig. 9, 1930.

[6] G. Chatterjee, *Nature*, Nov. 23, p. 793, 1929.

[7] *Proc. Zool. Soc.*, Part 2, 1933.

not get any reference to their presence in any of the previous literature'. Owen refers to these apertures in his *Comparative Anatomy of Vertebrates*, Vol. I, 1886. He mentions, speaking of the vertebræ of Ophidia, at page 53 of the book, that 'a vascular canal perforates the under surface of the centrum and there are sometimes two or even three smaller foramina.' Mookerjee's observations confirm Owen's statement for Typhlopidæ.

S. G. MANAVALA RAMANUJAM.

Presidency College,
Madras.

November 1933.

[Mr. L. S. Ramaswami of Bangalore has, in a communication sent to us, drawn our attention to the same reference.—ED., *Cur. Sci.*]

Research Notes.

Silicosis.

SILICOSIS is mainly a lung disease counting a high toll among the gold miners, sand blasters and quarry-men. Silica enters the lungs in large amounts as fine dust particles causing there the development of fibrotic nodules extending, in course of time from the midline to the periphery, inducing in men a pre-disposition to tuberculosis. A review of the theories on silicosis along with the rôle of silica in the system is presented by Dr. King (*Canadian Chem. and Metallurgy*, **17**, 146, 1933). According to Hefferman, silica gets embedded as the hydrosol in the phagocytes which become consequently vacuolated and die, the process spreading from cell to cell. The mechanism of this dehydration is not adequately studied. Policard considers a mineral impregnation to take place resulting in a sort of mummification of the protoplasm. According to King the silica content of the urine is influenced by the nature of the diet being larger when animals are fed with oats, cabbages, etc., and smaller on a diet of white bread and tomato juice. Silica is present as an invariable constituent of the protoplasm in the white and yolk of the eggs of birds, and other embryonic mammals. Direct administration of silica as finely powdered quartz into the stomach results in an enhanced output of this material in the urine. This value is still more abnormal when it is employed as neutralised sodium silicate. Silicic acid in saline, in dilute solutions, when given intravenous continuously for several hours, produces very high values in the urine. When this is, however, replaced by a fine suspension of particulate silica, much of this constituent is not detected in urine, but the urine becomes bloody resulting in anuria followed by death. The kidney had, however, a normal silica content while the spleen had a figure far above the normal. Organic derivatives of silicic acid affected the composition of the blood and urine without evil effects, suggesting a high tolerance of silica in this form. The author finally concludes that the increased output of silica is not apparently through the kidneys.

Corrosion of Tin and Iron.

CORROSION of tin and iron in tin cans used as containers for acid foods such as fruits is the theme of a contribution by Lipsett (*Canadian Chemistry and Metallurgy*, **17**, 171, 1933). In tin cans the iron is protected by a coating of relatively inactive metals such as tin, but where this coating has worn out, corrosion sets in causing pinholes. The occurrence of these spots in tin containers is explained as due to electrochemical action, the dissolution of iron at the anode taking place consequent on the evolution of hydrogen at the cathode and in view of the limited exposure of iron, the attack is strong resulting in the formation of a deep hole. Thus one would conclude that tin cans do not serve as ideal containers. The observed facts are quite contrary to our expectations for which an explanation has been sought in this communication. The coating of tin has a protective action on the exposed pinholes but the element that seems to suffer due to corrosion is tin itself. It is common nowadays to use enamelled tin cans to preserve coloured fruits, since their colour is bleached badly in these containers. Strangely enough, such decolorisation is hastened in the well lacquered holders. A third anomaly is traceable to increased acid content of the fruits whereby less damage is caused to the tin, in striking contrast to the general view that corrosion is accelerated by increased acidity. Explaining the first

of these anomalies the author draws attention to the fact that when tin and iron are held in electrical contact in an acid solution, the amount of tin dissolved is far greater than it would otherwise be, while under the same conditions iron behaves in exactly the opposite way. The electric potential between the tin and the iron is reversed and the iron is cathodic to the tin. The tin-iron couple, under anærobic conditions, behaves in a manner wherein the hydrogen liberated through the action of acid on tin protects the iron from being acted upon. Potential measurements carried out by the author confirm these practical observations. Coming to the products of corrosion, it is found that a very large part of the tin dissolved is in the insoluble state. It is also found that hydrogen accumulates in the sealed tins after utilising the oxygen of the air originally contained therein. The contents may be good to eat being sterile but the gas accumulation causes the cans to swell. The increased corrosion in the case of lacquered containers is not due to the action of acids on the lacquer, but to defective make up of the holders. In practice, tin sheets are lacquered before stamping out the ends, with the result that weak spots and abrasions are created in the process of stamping, in both the lacquer and tinned plate itself. It is then easy to understand the causation of leaks, especially at the ends occurring chiefly in the countersink. The tin here does not protect the iron, since the surfaces of tin and iron exposed to the acid are more or less the same. Whether the lacquer film favours this heavy corrosion is a point for further confirmation. It is hoped that this physico-chemical aspect will receive due attention in the several problems relating to food and food containers in whatever manner these are used.

V. I.

Some Factors affecting the Electrolytes of the Starch Granules.

THE starch granule is generally regarded as consisting of two parts, α-amylose or amylopectin forming the outer insoluble layer and β-amylose constituting the soluble inner part. The amylopectin fraction contains phosphorus and the fact that dephosphorisation considerably decreases the viscous properties of the materials which is restored by rephosphorisation suggests that phosphorus profoundly influences the viscosity of starch. Other electrolytes have been detected in starch granules from various sources (some of them may be regarded as adsorbed impurities) and the relationship between them and the viscosity of starch is not well understood. The problem is one of great practical importance as starch is extensively employed in arts and industries. In a paper published in the *Journal of Agricultural Research* (**47**, 179-91, 1933) Edwards and Ripperton have reported their findings regarding the variation of phosphoric acid and cations in starches of various origins, the nature of their binding and the possible significance of the results in practical industrial uses of starch and plant physiology. Analysis of a large number of commercial starches showed that phosphate was always present and gave characteristic values. The other constituents, calcium, magnesium, etc., varied within very wide limits. In the case of edible canna rootstocks it was shown that the observed drop in viscosity was correlated with the decrease in potassium and increase in calcium. This was not, however, true of stored potatoes. *In vivo* studies of the relationship between electrolytes in sap and the electrolytes associated with starch showed that there was no direct chemical equilibrium between the two. The conclusion that ionic absorption is specific and is not controlled by the electrolyte-concentration of the sap appears to be justified. Starch may function as a store for inorganic materials which the plant can utilise when needed. During germination, for instance, the phosphorus associated with starch is made available possibly in organic combination needed for early growth.

Intermediate Products and the Last Stages of Carbohydrate Breakdown in the Metabolism of Muscle and in Alcoholic Fermentation.

IN the course of a lecture delivered in the Biochemical Laboratory, Cambridge (Reported in *Nature*, **132**, 337–340; 373–375, 1933) Dr. Otto Meyerhoff has summarised the present status of our knowledge concerning the anærobic carbohydrate breakdown in lactic acid formation in muscle and in alcoholic fermentation. Esterification of the phosphates has been generally regarded as the first step in these processes. The stages following esterification, however, have

formed the subject of several important investigations.

From the living yeast and other intact cells and tissues as also from the muscle extract it is possible to isolate a hexose monophosphoric acid ester, which is actually a true equilibrium mixture consisting of about 70% aldose monophosphoric acid and 30% ketose monophosphoric acid. Embden observed that the addition of sodium fluoride inhibited the formation of lactic acid in muscles, at the same time producing increased quantities of hexose diphosphoric acid. Subsequent work of Lohmann (1930) showed that this acid was a rearrangement product of the ester isolated by Harden and Young, from yeast-press juice. Under conditions defined by Lohmann, glyceric acid monophosphoric acid (phospho-glyceric acid) is also produced and treatment of phosphoglyceric acid with minced muscle produced pyruvic acid, and α-glycero-phosphoric acid (a reduction product). Embden further observed, that simultaneous addition of phosphoglyceric acid and α-glycero-phosphoric acid to muscle tissue caused an increased formation of lactic acid twice as much lactic acid being produced as pyruvic acid disappeared, while neither pyruvic acid alone nor α-glycero-phosphoric acid was able to produce lactic acid when added to carbohydrate-free muscle extract. Thus the reaction is represented by—

$$\begin{array}{c} CH_3 \\ | \\ CO \\ | \\ COOH \end{array} + \begin{array}{c} CH_2OH \\ | \\ CHOH \\ | \\ CH_2O.PO_3H_2 \end{array} \rightarrow 2.\begin{array}{c} CH_3 \\ | \\ CHOH \\ | \\ COOH \end{array} + H_3PO_4$$

The inhibiting effect of sodium fluoride in lactic acid production from carbohydrates is due to the inhibition of that stage of the reaction responsible for the splitting off of phosphoric acid from phosphoglyceric acid. If, therefore, excess of pyruvic acid and α-glycero-phosphoric acid be added to muscle extract, as also enough fluoride to stop completely the anærobic breakdown of glycogen and hexose diphosphate, lactic acid is formed, and in the same amount as would be produced without the addition of fluoride; but the disappearance of pyruvic acid and formation of lactic acid are equivalent; thus—

$$2.\begin{array}{c} CH_3 \\ | \\ CO \\ | \\ COOH \end{array} + \begin{array}{c} CH_2OH \\ | \\ CHOH \\ | \\ CH_2O.PO_3H_2 \end{array} \rightarrow 2.\begin{array}{c} CH_3 \\ | \\ CHOH \\ | \\ COOH \end{array} + \begin{array}{c} COOH \\ | \\ CHOH \\ | \\ CH_2O.PO_3.H_2 \end{array}$$

The glycero-phosphoric acid is completely converted into phosphoglyceric acid.

The pyruvic acid and glycero-phosphoric acid do not react with each other directly to produce lactic acid, but one half is converted into triosephosphate which then undergoes rearrangement. The glycero-phosphoric acid thus produced can react again with pyruvic acid but the phosphate group of phosphoglyceric acid is not split off.

Considering the alcoholic fermentation, it has been observed that when phosphoglyceric acid is added to fresh yeast extract, CO_2, phosphoric acid, and acetaldehyde are produced. Again, when hexose diphosphoric acid is added to a fluoride containing yeast juice, the ester undergoes change and a mixture of phosphoglyceric acid and glycero-phosphoric acid in equal quantities is produced. Glucose alone is not esterified in the presence of fluoride, but the esterification takes place when glucose and diphosphate are simultaneously added to yeast juice, but the reaction stops when the quantity esterified is equal to the hexose diphosphate. Addition of acetaldehyde brings about other interesting changes. The reaction proceeds further, aldehyde is reduced to alcohol, the sugar is esterified, and converted into phosphoglyceric acid. The extent of the reaction depends on the amount of added acetaldehyde only a trace of hexose diphosphate which acts like a true catalyst being required.

$$\begin{array}{l} 2 \text{ acetaldehyde} \\ + 1 \text{ glucose} \\ + 2 \text{ phosphoric acid} \end{array} \underset{\text{(Hexose diphosphoric acid)}}{\xrightarrow{}} \begin{array}{l} 2 \text{ alcohol} \\ + 2 \text{ phosphoglyceric acid} \\ \end{array}$$

Acetaldehyde can be replaced by other reducible systems such as methylene blue. The mechanism of the reaction appears to consist of a reaction between the aldehyde and the nascent triose-phosphoric acid produced from the reaction between glucose and hexose diphosphate. The aldehyde also prevents the rearrangement of the triose-phosphoric acid into glycero-phosphoric acid so that the triose–phosphoric acid is quantitatively converted into phosphoglyceric acid.

"The difference between alcoholic fermentation and lactic acid fermentation is to be found in the fate of pyruvic acid while pyruvic acid in muscle extract is reduced to lactic acid by the glycero-phosphoric acid, in yeast, it is split up into CO_2, acetaldehyde which acetaldehyde is then reduced. This reduction is not accomplished by the glycero-phosphoric acid, but by some precursor probably the glyceric aldehyde phosphoric acid."

On the Placentation of the Harbor Porpoise (*Phocæna phocæna*, Linn.).

G. B. WISLOCKI in an important article (*Biol. Bul.*, Vol. **65**, Aug. 1933) describes the placentation of Porpoise. The existing literature on this subject is very scanty. The fœtus which is almost a fully grown one occupies more commonly the left uterine cornu and the fœtal envelopes extend into the right cornu also. But in this case, the amnion though larger than the allantois does not extend into the right cornu. The placenta is of the diffuse epitheliochorial type. Where the blood vessels are greater in number the attachment is also intense and *vice versa*. Further the characteristic features of the diffuse placenta, the presence of chorionic vesicles, are wanting. A sectional view of the umbalical cord shows the presence of vascularised stroma, resembling therefore the ungulates more than the primates. Prof. Wislocki assures us that in a future communication a detailed description of the umbalical cord, the stroma and the lymphatics will be made.

Cytology of Meiotic Cells in Schizodactylus.

C. E. MCCLUNG AND J. J. ASANA (*Journ. Morph.*, **55**, No. 1) report an interesting case of a cytological condition of the meiotic cells in Schizodactylus, an aberrant Orthopterous insect. The work of McClung and his students has established a fact that the chromosomes in this group of insects conformed to a certain type in their structure and behaviour. Obviously the case of Schizodactylus is an exception, for in certain important respects it differs from this type. Firstly, the chromosome number is astonishingly small, in fact the smallest in all Orthoptera, being only fourteen in the diploid condition. A second fact of importance is the evenness in number indicating the presence of a Y-chromosome unknown in the group except for some Gryllotalpa individuals. Another important feature in which Schizodactylus differs from other Orthopterous insects is the distinctive characteristics which make the identification of the different tetrads very easy. The fiber attachment is terminal though the larger chromosomes in the metaphase are J-shaped. The relatively small size of the chromosomes in the first spermatocyte is another interesting feature. In fact the authors think that in many respects the conditon in Schizodactylus recalls that in Chilopods described by Bouin and Blackman. The position of Schizodactylus in the group Orthoptera on the basis of anatomical characters is not clear. And the behaviour and structure of the chromosomes in this animal lend additional proof for the anomalous position of this animal.

Variations in the Oestrous Cycle of Guinea-Pig.

USING the vaginal smear technique, Thomas Nicol (*Proc. Roy. Soc, Edin.*, **53**, Pt. 3) has given excellent data for the determination of the variations in the œstrous cycle of the guinea-pig in the virgin animal, after parturition and during pregnancy. The duration of the normal œstrous cycle is about 16 to 18 days, though variations between 10 and 26 days have been recorded. Normally the vagina is closed by a thin membrane and during the period of sexual activity the orifice is kept open for about three or four days, afterwards closing again. During this period of heat the vagina is filled with a fluid which has been subjected to microscopical examination in different stages of this sexual activity. And on the basis of the vaginal smear preparations the œstrous period has been divided into four stages extending over a total period of 12 to 24 hours, ovulation occurring about the middle of this period. Observations on 368 cycles from 40 animals have yielded uniform results.

African and American Explorations.

IN the *Proceedings of the Academy of Natural Sciences of Philadelphia*, Vol. LXXXIV, for 1932, a series of articles based on the explorations into the various regions of Africa and America is reported. Besides descriptions of the African birds, the Herpetological and Avian fauna from Honduras and Fishes from Brazil, a new species of Sailfish, *Istiophorus, I. brookei*, is described from Tahiti. The account on the Reptiles and Amphibians from Honduras deals with seventeen Amphibians and twenty-six Reptiles. The ecological adaptations of the fauna at an altitude of nearly 5,000 feet, must be extremely interesting and we expect an account of this in the next issue of the *Proceedings*.

Origin and Classification of Pegmatites.

IN a recent number of the *Amer. Miner*, **18**, pp. 33-56 and 95-103, 1933, K. K. Landes

has published an interesting paper on the origin and classification of pegmatites. All theories of pegmatite origin are classified into two groups—aqueous and igneous—and further sub-divisions in each group are mentioned and discussed, especially the 'hydrothermal replacement sub-groups'. Examples of the various types of pegmatites included in the classification are given.

Contamination in Acid Magmas.

EVER since petrology, as distinct from petrography, came into its own, the rôle played by assimilation in the formation of igneous rocks has been the subject of repeated controversy. An interesting paper on 'Some theoretical aspects of contamination in acid magmas' by S. R. Nockolds appears in a recent number of the *Journal of Geology*, **41**, No. 6, wherein an attempt has been made to show what happens when foreign material is added to an acid magma and the various ways in which this material is incorporated. The author has definitely shown that "from a theoretical point of view, there are indications that diffusion into xenoliths should be accomplished by the volatile components of a magma and the simple salts which tend to travel with them, rather than by the complex silicate components." This diffusion of substance to and from a xenolith constitutes reciprocal reaction, and such diffusion will go on till it results in stabilising the mineral assemblage of the xenolith so that its mineral phases are in equilibrium with the contaminated magma. The actual gaining of various oxides by reciprocal reaction is not the only way in which the magma may alter its constitution. There are also other methods which may be loosely described as 'mechanical' by means of which the magma incorporates solid material from the invaded rock. Three main methods of incorporation may be noticed: (1) when the invaded rocks of xenoliths are not in equilibrium with the magma as regards all their phases, (2) when they do remain more or less in equilibrium, (3) when magma material is injected *en masse* into the xenoliths or country rocks at the contact.

Science News.

Mr. Muhammed Zakiuddin, M.Sc. (Alig.), Research Scholar, Aligarh, writes, "The first Society for the study of the Sciences was started by the late Sir Syed Ahmad Khan at Ghazipore in 1864. It was named the Scientific Society and its objects were:—(1) To translate in such languages as may be in common use among the people, those works of arts and sciences, which being in English and other European languages are not intelligible to the natives; and (2) To search and publish rare and valuable Oriental Manuscripts (non-Religous)".

The seat of the Society "was to be fixed ultimately at Allahabad but before the Society was set a thorough going it was to be where Sir Syed was stationed".

From 1864 the proceedings of the Society were published and an Urdu Journal was started known as *Tahzeeb-ul-Ikhlaque*—that served the Indians as *Tatler* and the *Spectator* did the Englishmen, and advocated the spirit of free enquiry and search after truth fearlessly. Later on when Sir Syed came to Aligarh, the Society was stationed where the present University Press stands. The Society showed a good deal of active service and the Duke of Argyll, the then Secretary of State for India, accepted its patronship. Mr. R. B. Qadri transferred the seat of the Society from the Gardens to the M.A.O. College in 1896, and this is the beginning of the relations between the Society and the College. In those days popular lectures were delivered and books were also published from time to time.

In 1907, Prof. Harrisson added fresh vigour to the Society at the opening of the B.Sc., Classes in the College, but unfortunately he left the College in the same year and it was not before Prof. Duncliffe took charge of the Science Departments that the Society was strengthened. In March 1915 Mr. F. D. Murad drafted a constitution for the Society pointing out that the object of the Society was to develop Scientific taste and to provide popular lectures on Scientific subjects.

About the same time Mr. Murad published the book "India's Neglect of Science and Scientific Education" giving in detail the activities of the Society.

In 1917 Prof. Dr. Wali Mohammad took the charge of the Science Departments and the Wali Mohammad Gold Medal was struck to be given for the best work done by a Science student. The activities of the Society went on, as it goes to-day and in 1920 it was registered as one of the Clubs and Societies of the University. It is interesting to note that the Indian Association for the Advancement of Science was started in 1876—12 years after the Scientific Society was started—by Dr. M. N. Sarkar.

The Society has led to other movements that has made Aligarh a hope for the future under the Presidentship of Prof. Dr. R. F. Hunter, D.Sc., Ph.D., etc., Nizam Professor of Chemistry in the University.

Side by side to the movement has developed another movement. In 1931, the erection of the New Science Laboratories (*Current Science*,

September 1933) started a new era in the history of Aligarh.

Professor Hunter inspired by the speech of Sir Abdul Qayoom published a plea for the establishment of an Association for the advancement of Science. Although at present we have got the Indian Association for the Advancement of Science it seems that we stand in need of some more such institutions that should undertake the publication of research work and memoirs, etc., the output of research in India being enormous.

The Association was started and it publishes a Proceeding that is distributed free to all the Libraries of the world.

The present President is Nawab Masood Jung Sir S. R. Masood, the Vice-Chancellor of the University.

* * *

The International Institute of Agriculture has recently issued a *Bibliography of Tropical Agriculture, 1932*, which contains a list, as nearly complete as psssible, of the articles on agricultural topics of the tropics which have appeared in periodicals of all countries. In addition to the usual bibliographical particulars, a short abstract of each article is given in French and English. The material is arranged in accordance with the type of crop treated under the following 15 headings, in addition to one on agriculture in general: Starch and Sugar plants; Oil yielding plants; Plants used for beverages; Narcotic plants; Textiles; Rubber yielding plants; Gums and resins; Plants for dyes; Perfume yielding plants; Spices; Medicinal and toxic plants; Fruits, Vegetables; Green manures, Cover crops, Shade trees; Weeds.

This bibliography, which is a continuation of that published last year for 1931, will be of inestimable value to the Agricultural Departments, the Research Stations and, in general, all persons concerned with questions of tropical agriculture.

* * *

In the Editorial on "The Marine Fisheries of India" that appeared in our last issue attention was directed to Mr. H. T. Sorley's Report on "The Marine Fisheries of the Bombay Presidency". It is now learnt that in pursuance of the recommendations made therein steps are being taken by the Government of Bombay to devise ways and means to improve the supply of fish to the city of Bombay and to ensure its proper distribution throughout the city. As a means to this end it has been decided to take on hire a motor launch from the Royal Indian Marine and use it as a collecting boat for 3 or 4 fishing boats so that fish actually collected by the fishermen will be brought to the place of landing by the motor launch. It is also proposed to take up some apprentices from fishing community for training in the driving of motor launches so that they may not be required to employ paid drivers in case they take up the idea of converting their present sail fishing boats into power driven boats. It is later proposed to build two boats of the same size as the present sail fishing boats equipped with Diesel engines and demonstrate them to the fishermen for the actual catching of fish. This is to be done with a view to impress upon the fishermen the advantages of power driven boats over their present sail fishing boats. With the assistance of motor driven launches fishermen will be able to land fish in a fresher condition than they have been doing at present.

This demonstration will be conducted by the Fisheries Inspector who, we understand, joined his duties about the middle of October 1933. His duties will not be confined only to the demonstration of power driven boats. He is expected to act as an adviser on all fishery matters and to carry out investigations which would ultimately lead to the development of fishing industry of the Bombay Presidency on modern lines.

In this connection Zoologists all over India will be glad to learn that Dr. S. B. Setna has been selected for the post of Fisheries Inspector in the Bombay Presidency. Judging from Dr. Setna's previous record in connection with fishery investigations, the choice seems to be a happy one. From the duties assigned to this post, it seems that there will be very few opportunities for the officer to pursue any comprehensive scientific investigations on fisheries, but it is expected that in spite of these difficulties much good will result even from this small beginning towards scientific exploitation of the fishery resources of the Presidency. The experiment will be watched all over India with considerable interest.

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We have pleasure in acknowledging the receipt of the first volume of the *Journal of Osmania University College*, Hyderabad (Deccan) which embodies the results of research carried on by the members of the staff in their respective departments. The Journal is under the management of a Research Board on which the professors are represented. Principal Mohammed Abdur Rahman Khan says in the Foreword that the University derives its name from the august appellation of H. E. H. the Nizam, whose public zeal and sagacity are well known and among the staff of the University are men of recognised position in education and science. "The spirit of research has caught hold of the mind of not only the professors, but also of that of the post-graduate students of the University College" and we congratulate the University on this excellent feature of their work, which we hope will be fostered and advanced by suitable encouragement.

For the present the Journal is intended to be published annually but we expect that as matter becomes available, it will appear more often. We do not quite understand the need of a separate journal for the publication of the work done by the post-graduates. If their papers are of sufficiently high quality and are fit to be published at all, they should find a place side by side with the papers of their professors. This procedure will fill the minds of the young researchers with confidence and hopes which will encourage continuous and better efforts on their part.

We welcome the Journal and wish it a long and prosperous career of increasing usefulness. The Urdu translation of the papers will help to disseminate knowledge among a wider public and the step that the authorities have taken is in the right direction.

* * *

Mr. M. N. Rudra, M.Sc., of the Prince of Wales Medical College, Patna, has developed a modified micro-method (see Kingsbury's *J. Biol. Chem.*, **75**, 241, 1927) for the estimation of normal urinary sugar. A 5 % solution of formaldehyde instead of 10 % as in the original method is recommended.

Consistent results are obtained and the method as modified proved very satisfactory for estimating small amounts of sugar in normal urine. It is also preferable to reduce the concentration of the reagent solution to 0·6 per cent. This modified method is now being employed for estimating sugar in normal urine.

* * *

Dr. K. S. Krishnan, D.Sc., Secretary of the Indian Association for the Cultivation of Sciences, has instituted three prizes to be given to the most successful students of the Dacca University, with a view to commemorate the services of the late Mr. Ramanujam, Sir C. V. Raman and Acharya Sir P. C. Ray in the cause of Mathematics, Physics and Chemistry respectively.

* * *

"The All-India Sugar Committee appointed by the Imperial Council of Agricultural Research in India is to meet at the Imperial Sugarcane Breeding Station, Coimbatore, 14th to 16th November, both days inclusive. Coimbatore has been chosen as the place for these meetings, as the Sugarcane Station here has been responsible for increasing the tonnage of cane in the Indian sugarcane belt—through new and valuable hybrids evolved at the Station—thus rendering possible the starting of additional factories in India. The direct stimulus to the opening of new factories in this country was the levy of a substantial tariff on imported sugar for a period of fifteen years on the initiative of the present Sugar Committee almost immediately after its inauguration in the year 1929."

"The Agenda of these Coimbatore meetings include important subjects such as the utilisation of molasses for power alcohol, results of experiments with cane crushers of various types, schemes for improving different products from sugarcane such as gur or jaggery, desi sugar and vacuum pan sugar, proper organisation for the full development of the Indian Industry, various investigations on the life cycle of sugarcane and its breeding, fixing of prices for cane delivered to the factory and zoning of definite areas to particular factories.

"Besides the Members and Co-opted Members scattered all over India, a large number of non-official visitors are expected to attend the meetings. Persons attending include leading business men, sugar technologists, sugar factory owners, sugarcane growers and Directors of Agriculture and Industries from the important Provinces."

* * *

An ordinary monthly meeting of the Asiatic Society of Bengal was held on Monday 6th November when Kavya Tirtha Ram Dhan, Dr. M. S. Krishnan, Mr. Arthur Lennox Coulson and Miss Gerta Hertz were elected ordinary members. The following papers were read and discussed :—1. *A few types of Sedentary Games of Lower Bengal* by Jatindra Mohan Datta; 2. *Sedentary Games of India* by S. L. Hora; 3. *Worship and Propitiation of Wild Animals at Uttarbhag, Lower Bengal*, by S. L. Hora; 4. *Worship of the Deities* Ola, Thola *and* Bon Bibi *in Lower Bengal* by S. L. Hora; 5. *On a few Ancient Indian Amulets and Charms* by Sarat Chandra Mitra; and 6. *Some Insects found associated with the Bitter-Gourd,* Memordica charantia *Linn (Cucurbitaceæ) in Calcutta* by S. Ribeiro.

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Forest Research in India, 1932-33.—The Report of the Forest Research Institute, Dehra Dun, which records the progress achieved during the year 1932–33, is a document of considerable interest.

In spite of drastic economy several problems of immediate value received attention, due regard being paid to problems of importance to forest departments in the provinces and problems connected with the growth of timber and utilisation of available forest produce. The publication of the manual "Commercial Timber of India" by Sir Ralph Pearson and Prof. H. P. Brown, both of whom were formerly connected with the Forest Research Institute, makes a distinct advance on the economic side of Indian Forestry. Mr. V. D. Limaye has prepared a report recording the mechanical and physical properties of 140 Indian Timbers. In the wood preservation section Mr. Kamesam carried out researches on the fixation of copper in wood.

Several other important researches were carried out during the year and results of practical utility have been obtained. Mention may be made of the work of the Paper Pulp Section which has established that bamboos (*Dendrocalamus strictus*) that have flowered and died yield a higher percentage of cellulose and paper than green culms, although drastic digestion is needed.

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We acknowledge with thanks the receipt of the following :—

"Nature," Vol. 132, Nos. 3333 to 3336.
"The Chemical Age," Vol. 29, Nos. 742 to 745.
"Canadian Journal of Research," Vol. 9, No. 2.
"The Journal of Chemical Physics," Vol. 1, No. 9.
"Berichte der Deutschen Chemischen Gessellschaft," Jahrg 66, No. 9.
"Natural History," Vol. 33, No. 5.
"Journal of Agricultural Research," Vol. 47, Nos. 1, 2 and 4.
"Experiment Station Record," Vol. 68, Nos. 1 to 5.
"Experiment Station Record," Vol. 69, No. 2.
"Science Progress," Vol. 28, No. 110.
"The Review of Scientific Instruments," Vol. 4, No. 9.
"Indian Forester," Vol. 59, No. 10.
"Medico-Surgical Suggestions," Vol. 2, No. 9.
"Bulletin of the State College of Washington, Agricultural Experimental Station," Bulletin No. 286.
"Contributions from Boyce Thompson Institute," Vol. 5, No. 3.
"Indian Journal of Physics," Vol. 8, No. 2.
"Journal of the Russian Chemical Society," LXV, Tom III, Livre 3.
"Journal of Entomology and Zoology," Vol. 25, No. 2.
"Journal of Agriculture and Livestock in India," Vol. 3, Nos. 1 to 5.
"The Indian Journal of Agricultural Science," Vol. 3, Nos. 1 to 4.
"The Indian Journal of Veterinary Science and Animal Husbandry," Vol. 3, Pts. 1 and 2.
"Annual Report of the Imperial Council of Agricultural Research" for the year 1931-32.
"Review of Agricultural Operations in India," 1929-30 and 1930-31.

Reviews.

RECENT ADVANCES IN ATOMIC PHYSICS. By Prof. Gaetano Castelfranchi. Approved translation by Dr. W. S. Stiles and Dr. J. W. T. Walsh. Vol. 1: Atoms, Molecules and Electrons, pp. xii + 360 + 12. Vol. 2: Quantum Theory, pp. xii + 400 + 12. (London: J. and A. Churchill, 1932. 15*s.* each volume.)

Prof. Castelfranchi's two volumes on "Recent Advances in Atomic Physics" are the latest in the field of books on Modern Physics. In the first volume we find very clear and logical accounts of the Kinetic Theory, Fluctuations, Electrons and Positive Rays, Isotopes, X-Rays and the Atomic Number, Crystals, Radioactivity, and the Atomic Nucleus. In the second volume are treated subjects like Radiation and the Quantum Theory, Spectroscopy, Stark and Zeeman Effects, Specific Heats, Photoelectric Effect, Compton Effect, Magnetism, Wave Mechanics and Quantum Mechanics, and the New Statistics. The method of treatment and the choice of subjects have an originality and charm of a high order. The writer has rightly laid emphasis on the experimental and technical side of the topics and developed a coherent account of the recent advances in Atomic Physics with as little mathematics as possible "avoiding all that is obstruse, all unnecessary elaborations of the argument, and all lengthy calculations which hinder a rapid comprehension of the subject as a whole by obscuring it in a mass of detail." In the second volume the last two chapters on Wave Mechanics and Quantum Mechanics and the New Statistics are particularly well executed. We feel confident that these two volumes of Prof. Castelfranchi can be recommended with profit to Honours undergraduates who want to have a grasp of the essential developments in Modern Physics. The bibliographies given at the end of each chapter will be of use to the more advanced student of Physics who wishes to have a deeper insight into the problems dealt with in the book. There are unfortunately some misprints—some of them obvious at first sight—which we hope will be looked into and rectified in the next edition of these two volumes. Leaving aside these slight imperfections, we must congratulate the author for the excellence with which he has presented to the reader a clear and concise account of the trend of developments in Atomic Physics. The translators deserve commendation for having done a real service to the English reading public by so ably bringing out the charm of the original Italian Edition.

WIRELESS TELEGRAPHY AND TELEPHONY. By W. Greenwood. Second Edition. (University Tutorial Press. Pp. 307. 5*s.* 6*d.*)

As a book for the serious beginner. Mr. Greenwood devotes an unnecessary amount of space to radio communication methods and apparatus which are either obsolete or fast becoming so. Chapters III and IV dealing with spark, arc and alternator methods of generating high frequency currents and of reception by different types of coherers could be almost completely omitted along with matters of merely historic interest as in Chapter V and elsewhere in the book.

The treatment of the physics and physical action of the thermionic vacuum tube as rectifier, amplifier and oscillator is inadequate and disappointing. There is complete absence of all necessary mathematical treatment. There is not even one diagram of a receiver circuit using a screen grid tube or pentode, let alone the later types. There is no mention of master oscillator driven systems; it is always the self-oscillator that gets connected or coupled to the antenna. Nor is there any information on the superheterodyne.

While Fleming, de Forest and Stead are mentioned for their contributions in the development of the thermionic vacuum tube, the names of Richardson, Langmuir, Thomson and others are not to be found.

Chapter IX gives brief descriptions of the different directional methods of transmission and of reception while the succeeding one deals with aerials and earth systems. In view of the rôle it plays in radio wave transmission, a short discussion on the ionosphere should have been included in Chapter XI.

The question of frequency measurements calls for more adequate treatment than what is contained in paragraph 170. Those who have even a brief experience with the working of the Duddell thermo-galvanometer will not readily agree with what Mr. Greenwood has to say on this instrument on page 236.

The last chapter deals with circuit analysis and will be found helpful by the beginner.

A few worked examples at the end of each chapter would have increased the use of the book as a text-book.

In the next edition, one hopes that Mr. Greenwood will forget or push back the experience he gained during his stay with the British Navy and present instead the results of his valuable study and experience as a research engineer of the British Broadcasting Corporation.

One hopes too that terms like "mutual induction" (page 28), "Oscillating Current" (page 28) and statements such as "Light and electromagnetic waves are the same forms of energy but of different wavelengths" (page 41) will not find any place.

The printing and general get-up of the book leave nothing to be desired; the diagrams stand out clear from the text and are a help to the reader.

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COMITE CONSULTATIF INTERNATIONAL DES COMMUNICATIONS TELEPHONIQUES A GRANDE DISTANCE. (Plenary Session, Paris, 14-21, September 1931. English Edition issued by the International Standard Electric Corporation, London, 1932, 362 pages. Price 21*s.*)

Though the C.C.I. is only a consultative body but nine years old its membership includes practically all the important telephone administrations of the world; its conclusions and recommendations, therefore, carry great weight.

This handsome volume of 362 pages forms the report of the Paris meeting in 1931 of the C.C.I. and presents an authoritative and comprehensive picture of the present status of long distance international telephone communication by wire and radio.

On the administrative side, the recommendations relate to organisation, operation, tariffs, priority of calls, traffic statistics, etc.

On the technical side are considered questions relating to maintenance, operation and supervision of lines and installations; technique and apparatus for a variety of telephone transmission measurement; reference and working standards for telephonometric measurements; examination of the different national systems in relation to international telephone transmission requirements; specifications for cables, apparatus and plant in a modern telephone system; protection of telephone lines against electrolytic corrosion; and many others. There are a number of technical articles from different organisations and manufacturing firms on apparatus and lines. Not the least useful part of the report is the extensive classified bibliography of articles in English, French and German spread over seventeen closely printed pages covering every aspect of telephone communications.

The reports of the plenary meetings are very interesting in showing the cordiality among the delegates and the spirit of mutual accommodation to promote the common objective of universal telephone communication.

Would that other international gatherings were as fruitful in their achievements as the meetings of the C.C.I.!

R. E.

* * *

FIFTY YEARS OF THE SOCIETY OF PUBLIC ANALYSTS. By Bernard Dyer and C. Ainsworth Mitchell, pp. viii+278; 4 plates. (Heffer and Sons, 1932. Price 12*s.* 6*d.*)

This work is divided into two portions, the first of which deals with the foundation of the Society of Public Analysts and its subsequent history on the administrative side. The work of each president is reviewed in detail and the important part played by the Society in developing the control of foods and drugs is explained. This consisted not only in the appointment of committees to deal with the technical aspects of all the more important branches of food analysis but also in carrying on negotiations with Government in order to obtain legislative sanction for their recommendations.

The second portion is a classified abstract of the more important papers which have appeared in "The Analyst", the organ of the Society, since its inception. These are grouped in decades and while this arrangement shows very clearly the expansion of the Society's activities, it is a little inconvenient if it is desired to trace the history of any one substance. This portion of the book also suffers, as from its very nature it must, in appearing to be a complete account of the subject, whereas in fact it is restricted to the publications in only one journal.

While primarily written for those having a personal interest in the Society, this volume should appeal to many others and particularly to those in India who are endeavouring to legislate for the control of foods and drugs. Many of the technical difficulties have been solved, although by no means all, but the legal and administrative difficulties still remain and a perusal of the book will indicate how vast these are,

while at the same time pointing out pitfalls which may be avoided.

H. E. WATSON.

* * *

SOLVENTS. By Thos. H. Durrans. Third and Revised Edition. 205 pp. (Chapman & Hall. 10*s*. 6*d*. net.)

The title of the above book belies its contents to some extent as it is solely confined to cellulose lacquer solvents. The reader who takes up the book with the idea of finding a general treatise on "Solvents" and the wide range of subjects which this word visualizes, is somewhat disappointed at the very narrow field dealt with. The title for a monograph can well be more explicit.

In all other respects the book is excellent and should prove extremely useful as a work of reference on cellulose lacquer solvents. The volume is divided into two parts. The first part deals in a broad and simple manner, with the scientific fundamentals of 'solvents' in relation to solvent action, vapour pressure, viscosity, etc. In Chapter IV the application of triangular co-ordinates for solving practical problems in the lacquer industry is dealt with in a simple and instructive manner, and a careful study of the method will be of considerable use to the reader in other branches of chemistry as well. Chapter VI includes tables of what are called 'Evaporation Periods' which are far too Empirical to bear publication.

The second part of the book is more utilitarian and deals comprehensively with individual solvents in the lacquer industry. In fact the material presented forms a regular text-book of industrial organic chemistry of the lacquer solvents. The concluding portion of the book contains a table of trade names of solvents and their probable composition, the intelligent use of which will save a good deal of time and money to any lacquer technologist.

The print and get-up of the book are excellent.

M. RAJAGOPALAN.

* * *

MANUAL OF PLANT DISEASES. By Frederick Deforest Heald, M.S., Ph.D. Second Edition. (McGraw-Hill Book Co., Inc. New York and London. 1933.)

The rapid progress of investigations on Plant Pathology in recent years, all over the world, resulting in a considerable output of literature on this important subject, makes it a difficult task to embody all the information in the form of a manual. And yet this has been achieved by Mr. Frederick Deforest Heald in his book. Though mainly intended as a text-book for students by the author who has been a teacher in Mycology for 16 years in the State College of Washington, this book, which contains quite a wealth of information and references, should be of great value to every research worker in Plant Pathology.

The symptoms of disease in plants, with a summary, are first described in such a way that it is intelligible both to the practical grower and the Pathologist.

The tendency for investigators in general, is to look for an organism fungal, or bacterial wherever a disease is concerned. Sec. II of this book is well worth studying by all Plant Pathologists, wherein are described in detail various diseases caused by deficiencies in food materials, and excessive soluble salts in the soil, by unfavourable water relations, by improper air relations, by high and low temperatures, by unfavourable light relations, by manufacturing processes such as cement dust, tar products, SO_2, etc., and by control practices themselves.

Sec. III dealing with virus diseases of plants has been written more elaborately than in the First Edition. During the last few years which, according to the author, may be designated as the "Mosaic Period", many new virus diseases of crop plants, and the rôle of insects in transmission have been brought to light. After a detailed description of some types references are given at the end of chapter to 149 virus diseases of plants.

Sec. IV which occupies the rest of the book deals with parasitic diseases. After a clear description of the morphology of bacteria, and their action on hosts, four important types of bacterial diseases are described. An exhaustive list of references is appended.

Then follows a description of a large number of diseases caused by fungi, arranged according to the groups to which these belong, only important types being chosen. It is difficult in the course of this review to bring out in full appreciation the wealth of information which these chapters contain. The chapter on "Diseases due to Rust fungi" deserves special mention for its lucid presentation. The last two chapters deal with diseases caused by Phanerogamic parasites and nematodes.

Such a valuable book can hardly be criticised for a few omissions under

references. Though some attempt has been made to include under "References" a few of the work on Plant Pathology done in India, it is felt that other valuable work done in India could also have been included.

In Chap. XXVII, under Parasitic Plants, the valuable work of Barber on Santalum Album, deserves mention. In Chap. XVI, under Diseases due to Downy Mildews, the pioneer work of Coleman on the Arecanut disease caused by *Phytophthora arecai* (1910), of Narasimhan on the heterothallic strains (*Phytopathology*, **20**, 201, 1930) and Uppal on Scleropora, could have been included. In Chap. XXVI, the disease on Coffee (*Corticum Koleroga*), which is a serious one in S. America, Mysore and other tropical coffee growing areas might have been referred to. To the references under Virus Diseases of Plants (Chap. XII) could have been added, the work done in India by Likhite on the Cytoplasmic inclusions in Mosaic tobacco, and by Narasimhan on the inclusions associated with Spike Disease of Sandal (*Phytopathology*, **23**, 191, 1932). These omissions of Indian Phytopathological work do not in any way detract the value of the book which should be in the hands of every research worker on Plant Pathology. The get-up of the book bears usual excellence of the publications of the McGraw-Hill Co.

M. J. N.

* * *

CYTOLOGICAL TECHNIQUE. By John R. Baker. (Publishers: Messrs. Methuen & Company, Limited, London. 3*s*. 6*d*. net.)

To a beginner in cytological technique, it is very essential that he should know what he is doing and what he is aiming at. More often irrational methods in the hands of a beginner yield very satisfactory results and the interpretation of the preparation becomes an arduous task unless he knows the principles and the chemical changes involved in the various stages through which the material passes before it is finally ready for examination under the microscope. The guiding principle of the author of this monograph has been to describe as few methods as possible and to present full information as to the nature of the reagents used.

In the routine laboratory practice the beginner is apt to use fixing and staining reagents in a haphazard way without knowing to what extent the results are due to the original components and to what extent they are due to their reactions.

In the introductory and the following chapter, the author gives a very clear exposition of the morphology of the cell and the principles and the chemical changes involved in employing the most common reagents like ethyl alcohol, acetic, picric, mercuric chloride and osmium tetroxide and enables the beginner in cytological technique to make a judicious use of these in the study of the cell.

The chapter on the fixing mixtures is a clear exposition of the nature of the reactions and particulary valuable in selecting reagents for the study of specific cell constituents. The small monograph is characterised by the care which the author has taken to make clear all matters which give difficulty to beginners.

The book is the outcome of the author's experience gained in cytological technique and records only those methods which have given the best results in his hands and is a welcome addition to books on microtechnique.

Though the study of the cell *intra vitam* is likely to be the basis of all future cytological investigation and the making of permanent preparations only an accessory to it, we have no hesitation in recommending this interesting monograph to all beginners in cytological technique as a very valuable and instructive guide to them in their endeavour to acquire proficiency in this field of scientific investigation.

A. N. R.

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JAPANESE FISHES. People interested in Fishery problems are no doubt aware that the fishing industry of Japan is probably the most highly organised in the whole world. The fisheries of Japan are exceedingly valuable; and the total value is believed to be at least £ 30,500,000 per annum, while the industry employs no less than 2,000,000 men. This remarkable result has been achieved within a comparatively short time through the application of scientific methods and the rational and economic exploitation of the fisheries.

During the last 20 years or more Dr. Tanaka has been studying the fishes of Japan mainly from a systematic point of view. Such a scientific work would not seem to some to be of any direct economic value, but it should be borne in mind that taxonomic work is the bed-rock on which almost all fishery investigations have to be based. Every country interested in its fisheries has

voluminous works on fishes, but a recent publication of Dr. Tanaka entitled "Japanese Fishes in Life Colours" is unique and a most useful handbook. It contains beautiful, coloured illustrations of over three hundred and fifty-five species, each one of which is briefly described both as regards its economic importance and systematic position. The size of the work is that of a pocket-book, so that it can be carried about very conveniently and its price has been kept low. Publications of a similar type dealing with the principal food-fishes of the various provinces of India will be a great boon to amateur naturalists and are likely to prove most useful to officers interested in the development of Indian fish resources.

Dr. Tanaka's book is written in the Japanese language, but the scientific names of the various species are given in Roman characters and there is a very good index at the end.

S. L. H.

* * *

THE SENSES OF INSECTS. By H. Eltringham, M.A., D.SC., F.R.S. Pp. vii+126 with 25 illustrations. (Methuen's Monographs of Biological Subjects. Edited by G. R. De Beer, M.A., D.SC.) (Methuen & Co., Ltd., 36 Essex Street, W.C. London. Price 3*s*. 6*d*. net.)

To students of Entomology and General Zoology this monograph will be an invaluable possession. Within a short compass, the author, a distinguished authority on insects, presents an extremely interesting account of the different types of sensory organs of these minute creatures, which can be read and enjoyed even by those who have only modest biological learnings. The information provided in each chapter is authoritative and up-to-date and the numerous illustrations assist in obtaining a clear understanding of the technical details and structural relations of the sensory organs. The intelligence displayed by insects especially by the social orders such as ants and termites implies not only the possession of highly developed sensory organs but also actually the powers of reasoning and judgment though in a rudimentary state. The complicated structure of the various organs of special sense is a marvel of mechanism and the manner in which the various parts are articulated to fulfil the special function for which they are devised must always remain a puzzling chapter in the philosophy of biology. In spite of a few technical terms indispensable in a book of this nature, one can read it with great pleasure and profit and we have no doubt that the reading public interested in obtaining accurate scientific information will welcome such biological monographs. A complete bibliography is given which will be useful to all wishing for fuller information with a view to undertake research.

* * *

FIGHTING THE INSECTS, THE STORY OF AN ENTOMOLOGIST. TELLING OF THE LIFE AND EXPERIENCES OF THE WRITER. By L. O. Howard, pp. xvii+333. (New York: The Macmillan & Co., 1933. Price 12*s*. 6*d*. net.)

This is a splendid book full of humour, interest and information. It deals with the practical application of scientific researches to combat the insect pests and the account is presented in an easy style and attractive form which will profit everyone who is interested in the contributions of science to the promotion of public health and the increase of public revenues. It is a record of the tireless efforts of a great man in organising an international campaign against the minor and major horrors of peace and war, with numerous autobiographical sketches of piquant interest.

Howard, a born naturalist, was originally trained for the medical profession which he abandoned to take up an assistant's post under Professor Riley who had been brought from Missouri to assume the appointment of Entomologist to the U. S. Department of Agriculture. Prof. Gage bade farewell to his old student in these words: "Now, Brother Howard, you and I are going to devote our lives to science. We are not going to let any confounded girls come between us and our work." While working in the Federal Bureau of Entomology in Washington he wrote in these words to his mother in 1884 about the share of credit which usually in those days fell to the lot of assistants: "Whenever you see a treatise by Professor or Dr. So and So in which he says in his introduction, 'I cheerfully acknowledge the help of my assistant Mr........' or words to that effect, you can make up your mind that the Professor wrote the introduction and the assistant the treatise." As soon as Howard became head of the department in 1897, he changed the old practice and permitted the assistants to publish their work in their name,—a reform which attracted to his service some of the eminent American biologists. When Howard was working as

an assistant under Constock, he became interested in parasitic insects and the natural control by parasites and predators and the interest so early formed in the study of these little creatures and of their extraordinary interactions, has continued all his life and the first fruits of his labours were embodied in a big paper on the parasites of coccidæ. The most dramatic episode of this period was the successful introduction of "Australian Lady Bird" which completely destroyed the fluted scale that threatened the extinction of the citrus industry of California. In 1894 when Riley resigned, Howard received the appointment as Chief of the Service and his efforts to focus the attention of Europe and America on combating the grapevine Phylloxera, the Gipsy Moth and Brown-tail Moth, the Mexican Cotton Boll Weevil, the discovery of the eggs of tachina fly on the army worm, the rice stem borer and on the unintentional interchange of injurious insects between countries through commerce, constitute the noblest chapter in the history of applied entomology. His experiments to introduce silk culture in the United States may have failed, but his attempt to establish international co-operation in overcoming and eradicating insect pests through natural control laid the foundation of the industrial prosperity of America and curiously, he never suffered from want of funds from the Government for carrying on his researches and founding expensive Laboratories.

The book has a strong human appeal. It is the story of a great scientist with an amiable simplicity of character who freely wrote and practised "internationalism" and endeared himself to every scientist in Europe with whom he came in contact. His account of the Cosmos Club, the Bicycle Club, his services in the preparation of the Century Dictionary and International Encyclopædia, his scientific expeditions and his description of Congresses and personal conversations, his work on mosquitoes and domestic fly, his public lectures and scientific addresses and every other detail of the career of this remarkable scientist, will form an enduring record of noble service cheerfully rendered for the advancement of knowledge and the promotion of human happiness.

To read Howard's "Fighting the Insects" is liberal education.

* * *

THE LIVING UNIVERSE. By Sir Francis Younghusband, pp. x+252. (London, John Murray, 1933. Price 10*s*. 6*d*. net.)

The book is rather of a mystic nature and propounds the theory conceived by philosophers of antiquity that the Universe is peopled by other kinds of life and in support of this doctrine, the latest findings of physical and biological sciences are made use of. The conception that the Universe is fundamentally material is abandoned and the possibility or probability of the existence of living beings in distant planets not recognised yet, forms the theme of the book.

Astronomy must have a great deal to say about the problem of the relation of life on this planet to the Universe of which it is a part and in conjunction with biology it will have some day to find a solution for the puzzling question of the origin of life and its ultimate destiny. Sir Francis Younghusband has gathered together the results of science and has given them the interpretation of an intuitive philosopher. The first two chapters deal with the ultimate facts of the Universe and the evolutionary process of life as stated by Jeans and Eddington, Wells and Huxley and Darwin. Mind can hardly be dissociated from life and its functions though limited by the physical framework through which both function, vary and expand in accordance with the character of the machinery and intuition is considered to be the line along which mind will develop in future. From creative love, Younghusband derives the mystical experiences of ecstatic world-love and it forms the main-spring of the Universe. Such experiences are not wholly subjective, for the mystic has a deeper sense of union with Nature and responds to the intimations which come from the world about him. The Universe is pervaded by the Cosmic Spirit which controls and directs it and the purposiveness and orderliness of it arise in a big thought of this Spirit. The realm of matter is subordinate to the governance of this Universal Mind. "I shall regard Jeans' principle of a creative intelligence as by no means tentative, but as the perfectly logical corollary of modern scientific facts." Sir Francis Younghusband makes a crucial point of this statement of Dr. Turner in regarding the Universe as an organism and argues that if our earth is part of it and has developed life and mind, then it follows that life and mind are characteristics of the Universe as a whole,—"that it was because

the Universe was a living Universe that life developed here". Then it is deduced that the Universe is not a mere machine but the outward face expression of the Cosmic Mind.

The book may not make an appeal to scientists of the type of Thomas the Doubtor, who want demonstrable evidence and those who would reduce the Universe to a mathematical formula. Scientists are becoming metaphysical and find it difficult to escape from conceding the existence of design and pattern, order and purpose in Nature under the Governance of an Agent to whom the Universe is as a venture. The book is an admirable exposition of the ancient doctrines of the Upanishads and upholds the dualistic system of philosophy. It is a valuable contribution to contemporary philosophic thought

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WHAT DARE I THINK? (A Challenge of Modern Science to Human Action and Belief.) By Julian Huxley, Professor of Zoology in the University of London (King's College). (The Phœnix Library, Chatto and Windus, London. Price 3*s.* 6*d.*)

The book contains a series of seven brilliant lectures which the author was invited to deliver at different places and at different times. We would place a copy of this stimulating work in the hands of lawyers, priests and politicians. The first three essays deal with some of the economic and social problems with which modern civilisation is confronted and the growth of human population, chiefly its quality in its bearings on social efficiency and economic salvation, offers to all thinking minds perplexing questions. In the first three essays the author in his search for a solution examines the contributions which biological investigations have recently made and untrammelled by sentiments, suggests that the practice of birth-control and eugenic sterilisation may offer hopes of solving the problem of population. Under what the author calls long range eugenics, selective breeding of human species must necessarily come in and one may doubt if man can be treated like peas and wheat for purposes of the application of Mendelian principles of selection. The next three essays deal with science and human nature and they give a vivid idea of the concept of scientific humanism. The author's interpretation of the implications and function of true religion and those of science is unexceptional, but all may not agree with him in thinking that the spirit of science is opposed to the conception of personal God, who "is imminent but not transcendent". Both religion and science are based on experience, the former is objective and latter subjective. Their conclusions must have different scales of value and the method of enquiry pursued by one is incapable of being applied to the other. But the validity of both depends on the fact of direct experience which may be introspectively analysed; the outer works of which in the case of science are verifiable evidence, but those in the case of religion must remain the fundamental fact of universal intuition which cannot be weighed and tested in the laboratories but can only be perceived in the innermost consciousness.*

The book is undoubtedly a notable contribution and is bound to exercise a great influence on contemporary international thought.

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THE MYSORE TRIBES AND CASTES. Vols. II, III and IV. By the Late H. V. Nanjundayya, M.A., M.L., C.I.E., and Rao Bahadur L. K. Ananthakrishna Iyer, B.A., L.T. (Published under the auspices of the Mysore University. 1928, 1930 and 1931. Price Rs. 12-8 or 20*s.* each volume.)

We congratulate the University of Mysore on the publication of these sumptuous volumes which undoubtedly form a signal contribution to our knowledge of the Tribes and Castes of Mysore. Rao Bahadur L. K. Ananthakrishna Iyer to whom the work was entrusted, is a well-known South Indian Anthropologist whose earlier works on the Cochin Tribes have earned for him the reputation of a sound scholar and as a lecturer in Anthropology in Calcutta University, he has had great opportunities of initiating research work in this important branch of science. The three volumes which we have read with unfeigned interest and profit, would form a noble tribute to a long and honourable life devoted to study and research. We are promised the first volume soon and we look forward to the pleasure of reading it with equal interest.

In the three volumes under review, about 92 Castes and Tribes are described and each volume is profusely illustrated with beautiful pictures of people in their typical

* The sensing of the ultimate nature of reality is one thing and the study of the laws of its manifestation in concrete expression is quite another thing.

costumes, or at their social functions or in their professional occupations in addition to pleasing photographs of famous temples and public institutions for which Mysore is well known. In his extensive field work, Mr. Iyer has collected a great amount of information regarding the historical origin of the several castes, their tradition, distribution, their habits, customs, manners, religious persuasion and practices, dress, furniture, marriage customs, divorce, ceremonies connected with child birth, inheritance, funeral ceremonies and occupations and industries and ornaments and social and economic status. Mr. Iyer from his extensive experience and knowledge is competent to draw certain generalisations based on his studies, in respect of the causes which have led to the bewildering sub-divisions of castes and the differences in their social behaviour even among groups which follow a common language and a common religion. What is the relation of these tribes to the Dravidian or the Aryan stock? Mere ethnographic work leads us nowhere, however valuable the study may be, if no attempt were made to trace the differences of social customs to some common origin and to trace the groups to a common ancestral stock. Cultural Anthropology as a descriptive science is exceedingly interesting, but we believe that this branch of knowledge is to be founded on Physical Anthropology and without measurement no science becomes exact. It is unfortunate that Mr. Iyer was unable to carry out any investigations on cranial measurements, structure of hair, form of nose, ear and eye in proportion to other anthrometrical features, relative proportions of limbs, the size and shape of feet and digits, the structure of nails, the hairiness of body and the shape and size of chin and forehead and everything about the physical organisation of the members of tribes which would disclose their original and mutual relationship. We hope that in the promised first volume of this interesting series, some reference will be found to this fundamentally important piece of work without which all ethnographical studies must be incomplete and we further hope that Mr. Iyer will stress the importance of the formation of a Museum in the State as a means of diffusion of knowledge about the people whose proximity takes away all incentive to closer study. Another point on which Mr. Iyer should have legitimately laid emphasis is the desirability of the University to introduce cultural and physical Anthropology in their scheme of studies and it will form an admirable combination with Psychology, Physiology and Zoology. With such abundance of material for study and investigation,—Mysore is a veritable Museum, and with little or no expenditure, we hope that Mr. Iyer will be able to induce the authorities to recognise the importance and need of instituting these fresh studies in the University of Mysore.

We have pleasure in acknowledging our sense of thankfulness to Mr. Iyer for providing us with genuine pleasure and interesting information which we have derived by a perusal of his volumes, and hope that others who have access to them will also derive equal profit by a perusal of these careful and painstaking studies.

* * *

HOMER AND MYCENÆ with 52 Illustrations and four maps. By Martin P. Nilsson, Dr. Theol. et. Phil, pp. xii+278. (Methuen & Co., Ltd., 36, Essex Street, London, 1933. Price 21*s*. net.)

There are numerous important contributions to the discussion of the Homeric problem and several theories have grown round it. According to the separatist school, Homeric epics are a patch work,—and the author being merely a compiler or redactor and the materials he has utilised pre-existed in the form of short epics or lays to which he added some of his own and later ages contributing others. It is almost impossible to settle the question of the authorship of epics of the magnitude and range of the *Illiad* and the *Odyssey* and it is even doubted if Homer ever existed beyond legends and myths. The unitarian school upholds that these works are the creation of the genius of a historical person and is not troubled with the pre-existence of independent lays and heroic poems. The literary criticisms on the heroic age of Greece are bewildering and it is doubtful if finality will be reached. The English Homeric scholars treat the problem as part of the genesis of epic poetry and others starting from archæological or ethnological considerations, end in discussing their bearing on the epic problem.

Martin Nilsson proceeds to examine the question from the standpoint of the probable contributions of Mycenæn culture to the epics of the heroic age. The archæological materials belonging to this age have thrown a flood of light on the influence of

this period and on the history of Greece. Historical researches into the archæological finds, the languages together with their dialects and ethnic problems, have established that Greece was occupied by a pre-Greek population whose civilisation was a modified form of Minoan culture from Crete. This pre-Greek or Mycenæn culture is divided into three distinct periods in accordance with the traces and gaps in it produced by the successive invasions of the Minoans. At the time the Greeks immigrated, the country had witnessed and bore evidences of a strong civilisation and as always happens, the immigrants must have absorbed the greater part of this pre-existing culture to which they added their own. Homeric scholars have divided themselves into two camps, one interested in taking the epics to the Mycenæn times and the other pushing them forward as late as the historical age. Nilsson considers that neither of these views is the right one. His researches are based not only on archæological elements in the Homeric poems, but extend to geographical and historical circumstances including State organisation, customs, religion and place names. Few can deny the fact that in Homer there is considerable evidence which refers to the pre-Greek civilisation or Mycenæn age and also to the Archaic age, the Geometric and the beginning of the Orientalising periods. The Mycenæn and Orientalising elements are separated by an age covering more than half a millennium. How is it possible that the former elements could have survived such a long gap and have been adopted in a composition belonging to a time at least half a millennium later?

The language and style of Homer present similar difficulties. The former is a mixture of several dialects chiefly Ionic interspersed with extensive Aeolic, Attic and Arcado-Cypriot elements. His style is distinguished by ornate epithets, used repeatedly in conjunction with proper nouns, especially with those of his heroes, Achilles and Odysseus, and another characteristic is the extensive use of stock expressions. The language goes back into very old times and the point of interest is how these archaisms were preserved down to his day. Most of these linguistic elements are Mycenæn, which as an age of great and heroic deeds, of warriors and princes, really forms the background of Homeric epics. The Homeric poems are founded on a mass of songs of minstrels which with countless variants based on the exploits of heroes, must have wandered from country to country before attaining the perfect epic technique with which Homer composed the tales of Troy and the wanderings of Odysseus. Certainly larger or smaller parts may have been added later on to Homer's poems. Still the general conclusion can hardly be resisted, *viz.*, "Owing to the epic technique and tradition elements from the Mycenæn age, in which epics first were created, were preserved down to the age in which epics underwent a renaissance, were fixed into two great poems, the *Illiad* and the *Odyssey*, and ultimately written down." The references to Mycenæn State organisation and the Mycenæn origin of Homeric myth and the contributions of that age to poetic fiction—all bear ample evidence to this general conclusion.

We have read a great book, distinguished alike for scholarship and for historical research. It is an enduring work bound to exercise a great influence on the future investigations into this most important and puzzling problem of Homeric poems. We congratulate the publishers on their enterprise in offering to the literary world a work of such excellence and on the splendid execution of their technical labours.

* * *

COLON CLASSIFICATION. By S. R. Ranganathan. (Madras: The Madras Library Association. London: Edward Goldston, Ltd., 1933.)

The Madras Library Association has commenced the publication of a series of books on library work of which "Colon Classification" by Mr. Ranganathan is the third. It differs considerably in various respects from the works on classification hitherto published. One of the main features which will strike even a casual reader is the very great minuteness of classification in most of the subjects treated, especially topics in Indology, which will be of immense use to librarians both in the East and in the West. The author deserves to be congratulated on his excellent performance. The book ought to find a place in every library, however small.

Errata.

Current Science, Vol. II, No. 4, October 1933, page 130, left-hand column, in the magnifications of the photographs—

for '70' *read* '56'
for '30' *read* '24'

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CONTENTS.

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The Problem of the Molasses.

THE discussions at the last Sugar Conference held at Simla (*Curr. Sci.*, **2**, 58, 1933) and the more recent meeting of the Sugar Committee at Coimbatore (*Curr. Sci.*, **2**, 202, 1933) have borne ample testimony to the fact that the provincial Governments as also the promoters of the sugar industry are quite alive to the seriousness of the new problem which they are faced with. With the creation of a number of new factories and the increased output of white sugar, the problem of the molasses has already assumed such serious proportions that it can no longer be ignored. In fact, we may even go further and state that when the protective tariff is withdrawn and the internal as well as external competition increases with the inevitable fall in prices, the intelligent utilisation of the hitherto neglected by-product may make all the difference between success and failure in the industry.

Not many years ago, India was importing quite considerable quantities of cane molasses, chiefly from Java. The imports have now very nearly disappeared and the home production so considerably increased that several factories have already got large stocks which they could not adequately dispose of. The present (1932–33) production may be reckoned at 450,000 tons and even a conservative estimate—based on the possible output of white sugar—would suggest that the manufacturers would be faced with the problem of dealing with no less than 500,000 tons during 1933–34 and subsequent years.

The problem of the molasses is not, however, unique to India. It is an inevitable consequence of the development of the white sugar industry and all the big sugar-producing countries like Java, Cuba, Natal, Hawaii, Mauritius, Queensland and Germany have had to face it. Various methods of utilising molasses (from cane or sugar beet) have been proposed and although none of them has proved wholly satisfactory, there is yet some evidence to suggest that at least some of them hold out promise of extended application. An attempt will therefore be made to critically examine the various methods now in use and to suggest a few lines along which further enquiry could be profitably undertaken.

The composition of cane molasses varies considerably depending on the variety of cane, manuring, system of boiling the juice, method of hardening and storage of the molasses and such like. It may be reckoned, however, on an approximate basis, that an average specimen contains about 40 per cent. of cane sugar, 30 per cent. of invert sugar (as glucose), 15–20 per cent. of moisture and the rest in the form of nitrogen and minerals. The nitrogen content is generally low, being under 1·0 per cent. but some specimens have been reported to contain higher percentages. Among the mineral constituents, potash (K_2O) accounts for a large share, being 1·9–4·6 per cent., and phosphoric acid (P_2O_5) 0·16–0·54 per cent. It is generally reckoned that molasses contains about 50 per cent. of the nitrogen originally present in the cane and 60 per cent. of the potash. Cane molasses can stand a reasonable amount of storage, but prolonged keeping leads to loss of sucrose, slow, irregular increase in invert sugar and general increase in non-sugars (Browne, *Ind. Eng. Chem.*, 21, 600, 1933). Recently, a patent has been taken for producing dry molasses by grinding the liquid product with alfalfa meal and spray-drying the mixture in a current of hot air (Amer. Pat. No. 1,897,732 of 1933), but further information regarding the cost of production and the keeping quality of the final product is needed before any opinion regarding the utility of the process can be expressed.

Among the various methods of utilising molasses those with the possibility of its consumption as food deserve the most careful consideration. It has been suggested that fancy sugar syrups can be prepared out of it, but with clean, white sugar plentifully available, it is very doubtful if there would be much demand for molasses. A similar criticism would also apply to the suggestion that it could be used for the manufacture of caramel. Anyway, the quantities consumed by such industries would be almost negligible as compared with the huge stocks of molasses that would tend to accumulate in the near future. The demand for use as animal feed would appear to fluctuate considerably, the sale of molasses bringing some useful return only when other feeds are scarce (Kerr, *Proc. 4th Congress Int. Soc. Sug. Tech.*, 1932).

The utilisation of beet molasses for the manufacture of yeast would appear to have received considerable attention in Germany. The yeast, thus prepared, is mostly taken up by the bread industry, but with the increasing knowledge of the high nutritive value of yeast, it is not unlikely that the product will soon find favour as an animal feed. Cane molasses is comparatively poor in nitrogen and buffers and tends to become more readily acid than the beet product, but this defect can be remedied by addition of suitable nitrogenous substances together with the necessary mineral salts. The yield of pressed (wet) yeast which, under favourable conditions, would be nearly as much as that of the original molasses would appear to be a useful return for the sugar and inorganic salts used up by the organisms.

In this connection it should be pointed out that the manufacture of yeast is a different process from that of fermentation to alcohol. In the former process, the yeast being the chief end product, the saccharine medium is enriched with nutrients and subjected to aeration so that practically no alcohol is formed. It is not necessary that typical fermentation yeasts (*Saccharomyces*) should be used for the manufacture: even pseudo-yeasts like *Mycoderma*, *Torulae* and *Sarcinae* which do not produce more than traces of alcohol, may be used for the purpose: in fact some of the latter would appear to be efficient than the fermenting yeast in converting a given weight of sugar into its body material. The use of pseudo-yeasts has a further advantage in that it requires no excise control. The final product is almost exclusively the mass of the living organism which is quite nutritious and eminently suitable for animal feed. It is even fit for human consumption and there is evidence to show that *Torulae* were used as human food during certain wars in France. The yeast can be consumed either in the wet condition or in the dry form. The drying is fairly easy and can be carried out either in the sun or in a current of hot air. The dried product which may be described as a form of concentrated food would contain nitrogen and the essential minerals in organic combination—a condition that is most desirable from the point of view of efficient assimilation—together with the related vitamins, and other valuable food accessories. The nutritive value of the final product would thus be very much greater than that of the original molasses, a fact which, if sufficiently known, would soon raise the yeast into a position of great favour with the farmers.

In recent years increasing evidence has also been obtained to show that yeasts and allied organisms contain certain ingredients which help to promote the growth of plants. More recently, it has also been observed that yeast extracts also help to increase the reproductive efficiency of plants (*Curr. Sci.*, **2**, 161, 1933). These and related observations would suggest that use of the dry yeast may soon find an important place in regular field practice.

From the above it would be seen that the manufacture of dry yeast (or an allied organism) from cane molasses is a promising line of enquiry which requires careful investigation.

Direct utilisation of molasses as fuel has been tried in a few countries, but the result does not appear to have been satisfactory. The product has low fuel value and added to that there is trouble with clinkering in boilers which is highly undesirable.

Among the various methods so far known, alcoholic fermentation for the manufacture of spirituous liquors and for the production of industrial alcohol would appear to be the most satisfactory way of utilising molasses. For various reasons, the consumption of molasses, by distilleries, has, so far, been only a small fraction of the total output, but it may be reasonably expected that, with more favourable conditions and improved methods of distilling for absolute alcohol, the major part of the molasses produced in the country would soon be taken up by that industry. In addition to its uses as a solvent and as an essential basic material for the manufacture of a variety of fine chemicals and pharmaceuticals, the utilisation of absolute alcohol, either by itself or in association with petrol (upto 30 per cent.) for internal combustion engines, deserves careful consideration. The merits and demerits of alcohol as a fuel have been indicated elsewhere in this issue (*Curr. Sci.*, 2, 202, 1933). Suffice it, therefore, to point out that if the difficulties associated with the illicit consumption of alcohol can be avoided; if the mixture of absolute alcohol and petrol can be moderately stabilised so that even if some moisture is absorbed, the two liquids will not separate; if the defects associated with incomplete combustion of alcohol can be eliminated; and if the problems connected with the transport and distribution of alcoholic petrol can be satisfactorily solved without imposing additional burden on the consumer, then the process of fermentation to alcohol will be one of the most satisfactory methods of utilising cane molasses.

A number of investigations have been carried out to study the possibility of utilising molasses in a number of minor fermentation industries such as those of lactic or citric acid, acetone and butyl alcohol or glycerin. Some of these studies have led to encouraging results, but the related processes are more difficult to control than that of alcoholic fermentation. The conditions of fermentation will therefore have to be carefully standardised if satisfactory yields of the desired products are to be obtained. The cost of manufacturing the different products should be compared with those by other known methods and the production adjusted to the limited demands of the market. The cost of manufacturing glycerin from molasses is stated to be less than that of recovery during soap manufacture but the estimates would require verification under the tropical conditions. The above and related subjects require further investigation.

A few years ago there appeared an announcement regarding the successful polymerisation of sucrose to yield a number of valuable solid and plastic materials (sakaloids). It was claimed by Ford, the inventor, that depending on the nature of the treatment, he could convert refined sugar or molasses into the following:—(1) A hard glassy substance which could be used as a glass substitute. The glassy material was claimed to be shatter-proof and to possess the advantage of being cut into the desired shape with a sharp knife: it was also found suitable for the manufacture of lenses and other useful articles. (2) A transparent substance with elastic properties and suitable for use as a substitute for rubber and leather. (3) A celluloid-like solid that could replace the inflammable celluloid. (4) A moulding powder that could be pressed to any desired shape in a hot press. A number of uses were contemplated for the new plastic materials both by themselves and in association with cellulose esters—artificial leather, wall hangings, adhesives, textiles, lenses, photographic films, transparent wrapping sheets, roofing tiles, paints and varnishes. It was claimed by the enthusiasts of the new process that 'the woman of the immediate future might look forward to being clothed from head to foot in spun sugar polymerised by the Ford

process, wearing shoes of sugar leather with heels of sugar plastic; write with a sugar pen from a sugar mounted bag, which contains an unbreakable sugar mirror, sit in a sugar plastic chair and watch a picture projected by a sugar lens through a sugar photographic film.' (Cited from *Int. Sug. Jour.*, **33**, 375, 1931.) Nothing has, however, since been heard of the process which started under such favourable auspices. It is not improbable that the cost of production which was reckoned to be 9½ cents. (5 As. at the present rate of exchange) per pound was found to be excessive as compared with casein and other plastic materials which could be obtained at cheaper rates. It would be of interest, however, to study the properties of sakaloid and such other sugar plastics with a view to determining whether they possess any rare properties which would entitle them to preferential use in some manufactures.

It has been stated that molasses can find application, in the foundry, as a substitute for core oils and core gums (*The Chem. Trade J.*, Nov. 9, 1928). A recent German patent (No. 537128) claims a method of manufacturing linoleum cement, a composition containing molasses, kaolin, copal and alcohol. These and similar uses deserve examination though it is hardly likely that any large quantities of molasses will thus be consumed.

In recent years a large amount of interest has centred round the utilisation of molasses as fertiliser. In some of the sugar-producing areas it was found difficult to dispose of all the molasses produced in the course of a season and since discharging the product into rivers tended to pollute the water and kill the fish, some experiments were carried out applying the molasses to land at the rate of 8—10 tons per acre. The result was unexpectedly favourable. Although the immediate effect of the application was to kill out the existing vegetation, the subsequent crops came out exceedingly well. In Queensland, the effect was most marked on soils which are naturally deficient in potash (*Int. Sug. Jour.*, **35**, 422, 1933). In Java, investigations have been in progress since 1911 mainly with a view to standardising the conditions for the application of molasses to land. As the result of these researches it may now be stated that application at the rate of about 1,600 gallons per acre, together with the irrigation water, is perhaps the cheapest method of application. The rice crop which follows benefits as the result of the treatment and increased yields averaging about 43 per cent. have been reported. The molasses can be applied either before or after trenching provided at least three weeks are allowed for the initial reaction to subside prior to transplanting. The application may also be made, after planting, either of diluted or undiluted molasses, on the ridges or in the trenches, in very diluted form (approx. 0·1 per cent.) with irrigation water, and of these, the first is preferable. Application of undiluted or slightly diluted molasses has nothing to recommend it. In general, the effect of application of molasses is marked in the case of the succeeding rice crop than in that of cane. In the latter case the fertilising value of the molasses would appear to be largely influenced by soil conditions and water supply (*Int. Sug. Jour.*, **34**, 416, 1932). In Hawaii, on the other hand, molasses would appear to have proved quite useful as a fertiliser for sugarcane. Marked increases both in the yield of cane and percentage of sugar have been reported. The molasses would also appear to have some useful residual effect rendering phosphoric acid and potash more available for subsequent crops. In addition to direct application to land, experiments would also appear to be in progress in Hawaii investigating the possibilities of preparing a solid, easily granulated and portable material by submitting molasses to a charring treatment with concentrated sulphuric acid followed by additions of raw rock phosphate, ammonium phosphate and other nutrients, which should produce a mixture having many advantages as compared with the original molasses. It is expected that treatment with sulphuric acid would not only render molasses easy to handle but that it would also increase the availability of added phosphates and potassic salts (*Int. Sug. Jour.*, **34**, 108, 1932). Another method that has been proposed by the Hawaii workers is to mix the molasses with begasse, filter press cake, furnace ash and other factory wastes and then apply the mixture to land. These proposals deserve careful consideration in connection with the disposal of surplus molasses.

The use of molasses as a fertiliser raises a fundamental question as to what it is that is mainly responsible for the fertilising action; how it is that the earlier vegetation are adversely affected while the subsequent crops benefit; why some time should lapse between the application of the molasses and the transplantation of the rice seedlings;

and how it exerts a residual action by increasing the availability of minerals though none of the molasses is left behind? After about twenty years of research, the Java workers have come to the conclusion that the fertilising action is mainly due to the sugars, the effect produced by equivalent amounts of minerals and nitrogen being very small as compared with that of the molasses as a whole. Study of the associated microflora has shown that fungi are prominent when molasses is applied in high concentration while yeasts and bacteria are in considerable evidence when the product is applied in a diluted form. The mechanism of the action of the different organisms has not yet been thoroughly understood, but judging from previous evidence relating to the decomposition of carbohydrates under similar conditions, it would appear that various organic acids are the initial products of the fermentation of molasses in the soil (*J. Agric. Sci.*, **19**, 627, 1929). The sugar as well as the free acids are, as such, toxic to the living plant, but, after a time, the sugar disappears and the acids react with the soil minerals rendering them more soluble. The buffer action of the soil helps to adjust the reaction. As the result of a succession of such changes the land becomes suitable for transplantation of crop after about three or four weeks. More mineral food being thus available, the plants make better growth and increased yields are obtained. Although the above would help to explain some of the hitherto obscure aspects of the problem, further research directed towards the elucidation of the biochemical mechanism of the decomposition of molasses during 'wet' and 'dry' cultivation is greatly needed. If the biological transformations can be properly controlled so as to avoid undue loss of carbon in the gaseous form or profuse leaching out of soluble minerals; if the field practice can be so standardised that the application of molasses can be carried out without any special equipment or technical advice; if increased yields corresponding to those reported from Java can be consistently obtained under Indian conditions, then the utilisation of molasses as a fertiliser would deserve extended adoption, even in preference to use in fermentation and other industries.

It would be hardly possible to do justice to all the aspects of the problem in the course of a brief review as the present one is intended to be. It is hoped, however, that the discussion would create some interest in the subject as a whole and that the promoters of the industry and scientific workers in the country will actively co-operate in organising and carrying out an intensive programme of research which would soon help to throw light on different hitherto obscure aspects of the problem. It may further be hoped that, as the result of such efforts, the conditions for the most profitable method of utilising molasses will be standardised and that the troublesome by-product of the present moment will soon become an important source of revenue to the sugar industry.

Asiatic Society of Bengal.

ON the 15th of January 1934, the Asiatic Society of Bengal, which was founded under the name of the *Asiatick Society*, on the 15th January 1784, by Sir William Jones, will reach the age of 150 years since its foundation The Society was founded to inquire into the history, civil and natural, the antiquities, laws, arts, sciences and literature of Asia, and during its long existence its usefulness has spread far and wide and it has to its credit a wonderful record of achievements.

The President and Council of the Society have decided to celebrate, on the 15th of January 1934, the 150th Anniversary of this foundation. The Anniversary programme will consist of a Conversazione in the Indian Museum, and a Banquet in the hall of the Society, followed by a special Anniversary Meeting to receive addresses from learned societies and to elect a number of Honorary Anniversary Members of the Society.

In connection with the centenary celebration in 1884 a volume depicting the progress of Letters and Science during the preceding 100 years was published, and it has been decided to undertake the preparation of a special volume on similar lines covering the period of the last 50 years.

Recent Advances in Palæontology in India.*

By D. N. Wadia,
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NOTABLE contributions to our knowledge of palæontology in India during the last 20 years have been along three main lines: (1) the investigation of the invertebrate palæozoic faunas from the ancient life-provinces of the Salt Range, Kashmir, the Chitral and Pamir region, and the Shan States of Burma; (2) the study of the rich mammalian faunas entombed in the Siwalik and older Tertiary fresh-water deposits of the Himalayan foot-hills and those of the Baluchistan and Burma highlands; (3) the detailed examination of groups of marine Mesozoic and Eocene[1] fossils, *e.g.*, the Jurassic cephalopods of Cutch, the Danian faunas of the *Cardita beaumonti* horizon, the basal Eocene mollusca of the Ranikot series and the Eocene foraminifera from the calcareous mountains of the north-west. To these must be added the revision of the fossil floras of the Gondwana system in accordance with the advances in palæobotany that have been made since Feistmantel carried out his pioneer investigations on the terrestrial fossil vegetation of India between the years 1863-86.

A number of important monographs on the fauna of the older Palæozoic and the "Anthracolithic" formations of the Himalaya, Burma and Salt Range by Dr. F. R. Cowper Reed,[2] have brought the problem of the geographical distribution of the life-provinces in the Palæozoic seas of India nearer satisfactory solution. In the field of invertebrate palæontology in India, Dr. Reed is the successor to Prof. Carl Diener of Vienna, who for many years before the War was a most valued collaborator of the Geological Survey of India in working out its collections of the faunal wealth of the Spiti, Kumaon and Kashmir Himalayas. As a consequence of detailed palæontological study, following closely on systematic mapping and collecting in the field by officers of the Geological Survey, the age of Permo-Carboniferous glaciation of India, a most important datum-line in the geology of the whole of the ancient southern continent of Gondwanaland, is now deduced with considerable precision to belong to a horizon at the base of the Uralian[3] or the top of the Moscovian stage—a horizon which is now accepted by Indian geologists as forming the bottom of the Lower Gondwana system of deposits in all parts of India.

Dr. G. E. Pilgrim[4] (now retired from the Geological Survey of India) has been the chief investigator of the Tertiary mammals of India during the last two decades. His notable contributions are memoirs on the Eocene ungulates from Burma, the Lower Miocene anthracotheroids from the Bugti hills of Baluchistan, the fossil pigs, giraffes and carnivores of India, together with a forthcoming comprehensive review of the hollow-horned ruminants which are so prolific in the Siwaliks. In a very suggestive paper† Pilgrim has discussed the problem of the inter-relations and migrations of the various groups of pre-historic mammals into and out of India during the Siwalik epoch, when India's population of the higher mammals was far greater than it is to-day. An important element in the mammalian fauna of the Siwaliks consists of the remains of creatures belonging to the most highly developed order of the primates, these constituting some 12 genera of anthropoid apes, extending in stratigraphic range from middle Miocene to early Pleistocene. The fossil primates so far discovered are, however, unfortunately very fragmentary and in the present stage of our knowledge no definite conclusions as to the probable lines of descent of these forms and their position with respect to the line of human ancestry in India can be safely drawn, yet the proof of the presence of a vigorous and highly differentiated family of the anthropoid apes (Simiidæ) in an epoch directly anterior to that of man, suggests that the idea of the existence of Upper Siwalik Man in India (the yet undiscovered Sivanthropus) may not be merely a dream.

Since 1920 our knowledge of the Mesozoic reptiles of India, especially of the extraordinarily diversified order Dinosauria, has been greatly increased by the finding of large quantities of vertebræ, skull, limb and

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* By permission of the Director, Geological Survey of India.

†Presidential Address, Geology Section, Indian Science Congress, Benares, 1925 (Asiatic Society of Bengal, Calcutta).

girdle bones, armour-plates, and teeth, from the Jubbulpur district, by Dr. C. A. Matley, working in co-operation with the Geological Survey. The systematic description of this material by Prof. Von Heune of Stuttgart, a recognised authority on fossil reptiles, and Dr. Matley,[5] has added 12 new genera and many species to the list of Indian dinosaurs, including the first records of the sub-orders Coelurosauria and Stegosauria in this country. The dinosaurs reached their highest development in India during the Lameta age in the Upper Cretaceous period.

Dr. L. F. Spath of the British Museum has completed his revision of the Jurassic Cephalopoda of Cutch, comprising 556 species of ammonites divided into 114 genera, the majority of these being the author's own creation, in six bulky memoirs of the *Palæontologia Indica*.[6] Dr. Spath has discussed interesting questions of Jurassic zoogeographical provinces, the affinities and comparisons of contemporaneous faunas from other parts of the world and the fascinating problem of ammonite phylogeny, in the investigation of which he finds the Hæckelian theory of Recapitulation, or as it is termed, "Biogenetic law", quite inadequate. The main elements of the Cutch fauna, according to Spath, are more closely linked to the fauna of the Indo-Madagascar province than to the Mediterranean (*i.e.*, Tethyan) area.

Among other noteworthy palæontological work of recent years may be mentioned the establishment of a remarkably well-developed Cambrian system in Kashmir,[7] containing a highly differentiated, but strongly provincial, fauna of trilobites, and of the Neocomian and Albian horizons in the Cretaceous of the Kohat[8] area. The value of Foraminifera as zone fossils in stratigraphic correlations of stages and sub-stages of the extensive Eocene and Oligocene calcareous development of the north-west, is brought out by the work of W. L. F. Nuttall and L. M. Davies. Palæontological research, there appear reasons to believe, may be the deciding factor in settling the much-vexed question of the age of the 'saline series' of the Punjab Salt Range and of the existence of powerful thrust-faults at the foot of the range. In this connection the recent discovery of foraminifera and fish remains by Mr. E. R. Gee of the Geological Survey of India from the Salt Marl associated with the salt deposits of these mountains is a notable event.

The pre-eminent position occupied by the Gondwana system among the stratified formations of the Peninsula has, from the earliest days of Indian geology, enforced attention to palæobotanical studies, not so much for the purpose of establishing chronologies, (for which the value of the evidence of plant fossils is still not fully established) but for the classification and inter-correlation of stages of the various widely scattered Gondwana outcrops of India from Kashmir in the north-west to the mouth of the Godavary in the south-east. In 1920 Seward and Sahni published a memoir on the revision of some Gondwana plants; this paper has drawn attention to the necessity of a comprehensive re-study of the great store of plant petrifactions, impressions, woods, fructifications, etc., belonging to the original material worked out by Feistmantel, as well as that collected by the Geological Survey during the last fifty years. The recognition of the Pteridosperms as a group distinct from the ferns and of the Bennettitales as distinct from the Cycads, along with the improved methods and technique of investigation of fossil plant-tissues that have come into use during recent years, have already caused considerable modifications in the grouping and nomenclature of Gondwana plants. Since 1925 the work of revision has been carried out by Prof. B. Sahni of Lucknow University and two memoirs dealing with the Coniferales,[9] besides several smaller papers on subjects of special interest, have already been published. Prof. Sahni is at present engaged on a comprehensive study of the post-Gondwana fossil Monocotyledons collected from various parts of India.

A magnificent collection of animal and plant fossils, the result of nearly seven decades' collecting by the Geological Survey, is stored in the galleries of the Indian Museum at Calcutta. Free access to these collections is given to both students and specialists and the Museum is indirectly furthering palæontological research by its system of exchange and presentation of duplicate specimens, casts, etc., to Museums of many parts of the world. Last year the Indian Geological Survey co-operated with the Yale University expedition in making large collections of invertebrate and vertebrate fossils from the Permo-Carboniferous of the Salt Range and the Siwalik deposits of the Potwar, Simla and Kangra areas, and with the British Museum Percy Sladen

Trust party in collecting fossil reptilian remains from the Central Provinces.

A welcome sign of the time is the interest taken in palæontological work by some of the younger workers in Indian geology. Considering the serious and often unsurmountable limitations to palæontological research by those beyond the reach of organised departmental centres, *e.g.*, properly equipped libraries and museums, the progress, though yet not great, gives cause for satisfaction. Besides some excellent palæobotanical work produced by Prof. Sahni's students, the Zoology and Geology departments of the Mysore University, the Geology laboratory of the Presidency College, Calcutta, and, lately, that of the Benares Hindu University are making creditable endeavours to start palæontological research on the right lines.

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The Indian Sugar Committee Meeting at Coimbatore.

THE Sugar Committee of the Imperial Council of Agricultural Research held its sixth meeting at Coimbatore on the 14th, 15th and 16th November 1933, under the Chairmanship of Dewan Bahadur Sir T. Vijayaraghavachariar, Vice-Chairman of the Imperial Council of Agricultural Research. Of all the Committees set up by the Council, the Sugar Committee has been the most active and has contributed materially to the development of the Sugarcane Agriculture and Sugar Industry of India. Within the space of three years, the achievements and the future programme of the Committee have gone far beyond the expectations on a five-year plan. This is evident from the periodical reports of the discussions of the Committee, which having provided adequately for the growth and development of sugarcane agriculture and industry, is applying itself to problems on the equal distribution of profits between the grower and the miller, to the establishment of a central Sugar Research Institute, and to the profitable utilisation of the by-products and waste products of the industry. The grant of protection to the industry and the creation of new and better varieties of sugarcane by Rao Bahadur T. S. Venkataraman, have been responsible for the phenomenal development of the sugar industry in this country. While in 1930-31 only twenty-nine sugar factories were operating in India, fifty-seven factories were in operation in the season 1932-33, and a total of over 120 factories are expected to operate during the coming season.

This being the first time the Committee visited Coimbatore, the several members went round the thick and thin breeding stations and acquainted themselves with the several phases involved in the evolution and distribution of improved varieties of sugarcane. Rao Bahadur T. S. Venkataraman, the Government Sugarcane Expert, and Mr. N. L. Dutt, the Second Cane Breeding Officer, showed the members and visitors round and explained to them the several phases of the science and art of sugarcane breeding, their joys and sorrows in the preliminary selection and rejection of seedlings and their successes and failures and hopes. Mr. Venkataraman also showed the interesting collections of wild sugarcanes and his new creations—the sugarcane x sorghum hybrids—and wound up with a graphic description of how his cane breeding station had already materially contributed to the advancement of the cultivator and the industry and what further improvements could be expected. These morning visits besides enabling the Committee to gain first-hand knowledge of

the fundamental work leading to the growth of the industry, were instructive to the lay visitor in showing what science, state protection and direction by a committee of experts in the line can do.

Of the several items of business transacted by the Committee, judging from the press reports, the most important and the most difficult subjects discussed were those dealing with the distribution of profits, the establishment of a Central Sugar Research Institute and the utilisation of molasses for power alcohol production.

The discussion on the distribution of profits and the methods of doing it is a subject of considerable interest all round and is beset with several difficulties. The grower and the miller are the active participants in sugar production and it is therefore reasonable that both should participate equally in the profits. It should be more assuredly so, when there is protection. While the axiom is easily stated, there are several practical difficulties in devising ways and means of ensuring the equal distribution of profits. This was one of the subjects discussed at the Simla Sugar Conference in June last without arriving at a decision. Since then, there have been several discussions in the press both from the point of view of the grower and the miller. Some suggest the raising of the price of jaggery or gur, some suggest the removal of surcharge, while some opine that the miller in his own interests will necessarily have the interests and the well-being of the grower at heart. None of these suggestions, however, adequately solves the problem. Each is defective in one way or the other and there are several opportunities for abuse. This being so, it is gratifying to note that the Committee tackled this difficult problem carefully and have taken the first step forward in recommending that legislation should be undertaken by which the price paid to the grower would be linked up with the profits made by the sugar factory and in suggesting that each province should legislate according to its conditions. While this is satisfactory so far as it goes, the means of attaining the end remains to be settled. Various formulæ were suggested for linking the price paid to the grower with the profits made by the factory. These have obvious advantages and are attendant with all the alleged risks existing now. The problem is not peculiar to India. It was in existence in the beginning in all the sugar-producing countries but was eventually solved by arriving at suitable working arrangements. It will be interesting to examine their methods of dealing with the problem.

Sugarcane for mills is generally grown under one or more of three systems: 1. entirely by the mills (rare in India but a regular feature in Java), 2. entirely by agriculturists (the usual practice in India), and 3. partly by mills and partly by agriculturists. The question of payments comes in only in the case of 2 and 3. In Java, the factories usually raise their own cane. When they buy sometimes, they do so from large estates on an agreement by which the profit is equally shared. On the side of the estate the total cost of growing cane and delivering it at the factory weigh-bridge are computed and the mill in its turn calculates the total costs of manufacture, packing, etc. Samples of cane at 5 to 10 per cent. of the quantity delivered are crushed and analysed daily and the available sugar on cane is calculated by a formula which varies with the variety of cane. In Mauritius, the agriculturist gets two-thirds of the sugar produced in the factory in return for the cane supplied. In Queensland the price of cane paid to the growers by the mills is strictly under the supervision of the Government who appoint for the season, at each mill, a Government Check Chemist whose business it is to see that sampling and analyses of consignments of cane, are properly done. In the British West Indies, the payment is made on a basis of 55 per cent. of the value of D. C. sugar manufactured for commerce. The system of payment in Antigna is that the planters receive as a first payment the value of $4\frac{1}{2}$ pounds of 96° sugar for every hundred pounds of cane supplied and at the end of the season they receive a further payment on the basis of fifty-fifty participation in profits. Natal and Zululand in South Africa, according to Maxwell, stand alone in the matter of irrational payment for cane based on weight and with no reference to quality. It is therefore clear that the regulation of payment for cane is not, after all, an impossible proposition. The great difficulty in India is that sugarcane cultivation is largely in the hands of peasants and generally illiterate farmers, who employ a middleman to sell their crop to the factory, but this is not an insuperable difficulty. The first requisite is the evolution of a formula by which it should be possible to calculate approximately from

the analysis of first mill juice, the amount of available sugar and there should be no difficulty in obtaining this information if the mills and departments of agriculture set to work together.

An item of considerable interest is the decision of the Committee to establish a Central Institute for Sugar Research. As would be expected, the earliest efforts at resuscitating and establishing the Indian Sugar Industry were first directed towards the most promising and fruitful lines of work. On one side impetus was given for the production of raw material by way of evolving new varieties of sugarcanes and by encouraging provincial agricultural departments, with or without grants from the Council funds, in carrying out cultural and manurial experiments, by setting up an organisation to study the economics of sugarcane cultivation and by bestowing attention on the technology of sugar manufacture. Progress in these directions having reached a definite stage, the Committee have recognised the necessity for sustained and comprehensive research and at its Coimbatore meeting approved separate schemes for research on the Chemistry and Anatomy of sugarcane and sanctioned the establishment of a Central Institute for Sugar Research. In these days of rapid scientific progress and severe competition from outside, no industry can hold its own without continued and efficient research in all its phases and more so with sugar industry in India. The methods of cultivation and manufacture developed with older types of imported canes need re-examination and new creations have yet to be studied in greater detail. The indigenous methods of sugar production which are best suited to the conditions of the peasant cultivator need examination and modification. The older ones were largely empirical and are rule of thumb methods which the cultivator himself has worked out with almost scientific precision. The methods vary widely in different areas and are applicable strictly to the localities in which they are developed. When attempts are made to translate practices from one locality to another they have, as would be expected, the disconcerting habit of failing frequently because of their empirical nature. In spite of the rapid progress in white sugar production, jaggery or gur making will continue, at any rate for some decades, to be an important product of sugarcane. While all the facilities that science offers are readily requisitioned for service in the manufacture of white, crystalline sugar, the application of science and the development of suitable methods for jaggery or sugar production on a cottage industry basis, has not received adequate attention. It is, therefore, pleasing to note that the Committee have not lost sight of this problem of tremendous importance to the peasant cultivator and provided for research in this field. In this connection the members of the Sugar Committee were very much interested to see at the Central Farm of the Agricultural College and Research Institute the whole of the new process of Cream jaggery manufacture with the use of activated paddy husk charcoal recently evolved at Coimbatore and the Committee were impressed with the simplicity of the process and the superior quality of the product. Completeness of organisation for research and its centralisation are essential for success and the Committee have not only recognised this but have taken the big step forward in sanctioning the establishment of a Central Sugar Research Institute.

The Committee spent anxious time and thought on the problem of the production of power alcohol from molasses and on the consequential legislation for its use, blended with petrol, as motor fuel. The problem of molasses disposal is a necessary evil arising out of white sugar industry. In October 1932 this subject was under discussion at Coimbatore jointly by the Society of Biological Chemists (India), the Indian Chemical Society (Madras Branch) and the Association of Economic Biologists. Within one year from that date, the problem gained both in size and momentum and ranked itself as one of the most urgent problems facing the sugar factories. Representatives of sugar factories were anxious to have legislation permitting the production of power alcohol and for the compulsory use of a mixture of alcohol and petrol as motor fuel. The proposition is attractive but is beset with several practical difficulties. In dealing with this subject the Sugar Committee was cautious and decided that the most important step was to carry out an experiment for the marketing and distribution of power alcohol in admixture with petrol as motor fuel in a limited area. This decision while providing adequately for research on the most urgent problem of the factory owner, does not involve the public in uncertainties and losses attending

on compulsory general legislation. The alcohol-petrol blend as a source of fuel for internal combustion engines is not yet an entirely successful and proved proposition fit for universal adoption. It is true it is being used in Germany, France and Italy. In America, where it is said to be in vogue, the American Automobile Association carried out several investigations in co-operation with the Secretary for Agriculture early in 1933 and issued two leaflets dated March and June 1933. According to the report of the American Automobile Association, alcohol is materially lower in heat value than gasoline and therefore requires adjustment of carburettors for equal performance compared with gasoline. Alcohol has the property of absorbing moisture and this results in the separation of alcohol and petrol in the blend and involve carburation and starting difficulties. In addition, increase in maintenance cost of motors may be expected owing to the deleterious effects on various parts of the system. Based on these observations, the Board of the American Automobile Association finally stated that hundreds of tests conclusively showed that an alcohol gasoline blend would be a great deal less efficient than regular gasoline and that its universal and compulsory use would add to the cost of up-keep. In the light of this experience, the decision of the Sugar Committee to carry out preliminary experiments is undoubtedly based on a very careful examination of the question in its several aspects.

This is about the disposal of factory molasses. There is still the problem of the disposal of molasses from small factories which manufacture white sugar by the open-pan system. The accumulations from individual factories may be small relatively, but in the aggregate the quantity of molasses produced will be larger than that from big factories. Even if the manufacture of power alcohol and its use as motor fuel with petrol materialises, it will not be a paying proposition for the open-pan sugar producing concerns to transport his molasses to a central distillery. The disposal of this type of molasses still constitutes a problem, and calls for investigation. Taking everything into consideration the most promising line of development appears to lie in the use of molasses in agriculture itself for manurial and feeding purposes. This kind of disposal is already in vogue in Java, Hawaii and other sugar-producing countries, but it is necessary to carry out investigations with reference to Indian conditions before agricultural departments in India are in a position to make specific recommendations. A comprehensive scheme of research on the effect of molasses on the soil in regard to its physico-chemical and bio-chemical characteristics, on its effect on crops and on its value in the feeding of farm animals has been in progress at Coimbatore this year and some interesting and valuable data have already been obtained.

When considering the Indian Sugar Industry one has always to remember that the Industry will need to face World competition if and when protection is withdrawn in the fulness of time and the utilisation of waste and bye-products is one way of stabilising the Industry against such competition.

The Committee also considered and discussed annual reports of the various schemes previously sanctioned and fair progress was evidenced in all directions.

B. VISWA NATH.

Indian Science Congress.

IMPORTANT NOTICE.

OWING to the continued plague epidemic in Poona which has only slightly abated, the venue of the Congress at Poona would have entailed special measures, such as obligatory inoculation of all visitors. The Local Committee, as well as the Congress authorities, have very carefully considered the situation and finally decided to avoid the inconvenience and possible danger of a meeting at Poona. In consultation with the University authorities in Bombay it has been decided to transfer the venue of the Congress from Poona to Bombay. The original date of the opening of the Congress (2nd January) remains unaltered.

Letters to the Editor.

Negative Viscosity of Solutions.

JONES AND DOLE (*J. Amer. Chem. Soc.*, **51**, 2950, 1929) and Falkenhagen and Dole (*Phys. Z.*, **30**, 611, 1929; also see Falkenhagen, *Phys. Z.*, **32**, 745, 1931) have treated the problem of the variation with concentration of the relative viscosity of electrolytes from the standpoint of the ion-atmosphere theory of Debye and Hückel and shown that at high dilutions the electrolyte must always increase the viscosity of the solvent and that the relative viscosity of an electrolyte solution at high dilution must be represented by an equation of the form

$$\eta_c/\eta_0 = 1 + K\sqrt{C}$$

where η_c is the viscosity of the solution,
η_0 is the viscosity of the solvent,
C is the equivalent concentration, and
K is a constant which can be determined in terms of certain constants of the electrolyte and the solvent.

It is well known that certain salts of some of the alkali metals show "negative viscosity" within a certain range of concentration, *i.e.*, the solutions are less viscous than the pure solvent. According to the theory of Falkenhagen and Dole, in very dilute solutions the viscosity should increase with concentration upto a certain stage even in instances of negative viscosity. A tendency to this effect was noticed by Schneider ("Dissertation", Rostock, 1910) in the case of potassium chlorate and by Bousfield (*J. Chem. Soc.*, **107**, 1781, 1915) in the case of nitric acid.

Recently Joy and Wolfenden (*Nature*, **126**, 994, 1930; *Proc. Roy. Soc.*, **134**, 413, 1932) have shown by very accurate measurements that the viscosity of solutions of potassium chloride, potassium chlorate, rubidium nitrate and nitric acid at high dilutions is greater than that of pure water and that the limiting slopes of the η_c/η_0, $\sqrt{C}$ curves and their temperature coefficients agree, within the experimental error, with the values predicted by the Falkenhagen-Dole equation.

In our laboratory we have carried out recently measurements of viscosity at 30°C with an Ostwald viscometer of solutions of chlorides, iodides and nitrates of potassium and ammonium in water and methyl, ethyl and n-propyl alcohols and observed the following:—

(1) Chlorides, iodides and nitrates of potassium and ammonium in aqueous solutions show negative viscosity within a certain range of concentration (*cf.* Getman, *J. de Chim. phys.*, **5**, 344, 1907; *J. Amer. Chem. Soc.*, **30**, 721, 1908; Herz and Martin, *Z. anorg. Chem.*, **132**, 31, 1924; Simon, C. R., **176**, 437, 1923 and others).

(2) In methyl and ethyl alcohols potassium chloride and ammonium chloride alone show negative viscosity.

(3) In n-propyl alcohol only a tendency for negative viscosity is marked in the case of potassium chloride.

(4) In all the above cases of negative viscosity, the relative viscosity increases with concentration upto a certain stage in very dilute solutions.

The last observation is in agreement with the requirements of the Falkenhagen-Dole theory. The observations with the Ostwald viscometer in dilute solutions are however not so accurate as can be used to test the theory quantitatively. These cases of negative viscosity are being investigated by using a more appropriate type of viscometer with an automatic arrangement to record time of flow.

H. N. DESAI.
D. B. NAIK.
B. N. DESAI.

Physics Laboratory,
Wilson College,
Bombay, 7,
September 22, 1933.

A Formula for the Variation in the Scattering of Light in Colloids during Ageing and Slow Coagulation.

IN a previous communication I have stated that the time-Tyndall intensity curves obtained with silicic acid sols during ageing are distinctly S-shaped, being curved convex to the time axis at the commencement and becoming concave towards the end. An explanation for this was offered, and an equation was then derived, which was found to represent the variation of the intensity of scattered light with time very well. The general equation is:—

$$I = c + \frac{k}{1 + b \cdot e^{at}}$$

where I is the intensity of scattered light, t is the time from the start, and a, b, c and k are constants, which could be found by

calculation for a particular sol. The following tables give the calculated and observed values of the Tyndall intensity, and it will be seen that the agreement is good.

Sol. A.—

$$I = 5\cdot 7 + \frac{24\cdot 28}{1 + 126\cdot 71\cdot e^{-0.1146.t}}$$

Time	I (Cal.)	I (Obs.)
10 days ..	8·1	8·0
13 ,, ..	10·5	10·5
16 ,, ..	14·2	14·3
18 ,, ..	17·3	17·4
20 ,, ..	20·4	20·0
23 ,, ..	24·5	25·0
27 ,, .	27·7	27·6
30 ,, ..	28·9	29·0

Sol. B.—

$$I = 7\cdot 4 + \frac{18\cdot 63}{1 + 146\cdot 82\cdot e^{-0.1271.t}}$$

Time	I (Cal.)	I (Obs.)
8 days .	8·6	8·7
9 ,, ..	9·0	9·0
10 ,, ..	9·5	9·5
11 ,, ..	10·1	10·0
13 ,, ..	11·7	11·6
14 ,, ..	12·8	12·8
15 ,, ..	14·0	14·0
18 ,, ..	18·0	19·0
20 ,, ..	20·5	20·5
22 ,, ..	22·5	22·0
29 ,, ..	25·5	24·6

Similar S-shaped curves have been obtained by me while examining the variation of the scattering of light and viscosity with time during the formation, ageing, and slow coagulation of colloidal solutions, and have also been observed by others in the case of the change of viscosity with time during coagulation. It has already been recognised that results such as those given above cannot be represented by von Smoluchouski's equation for coagulation. But the equation suggested above, fits in very well with the data on ageing and slow coagulation obtained by me and other workers, and can easily be derived from theoretical considerations, as will be shown in a paper to be published shortly.

I pointed out the usefulness of this equation in an address to the Nagpur Chemical Society about three years ago. Recent investigations have convinced me that it could be applied with advantage to the results giving the variation of light—scattering in sodium oleate solutions with time at 20°C, and in the formation and slow coagulation of sols.

K. KRISHNA MURTI.

College of Science,
Nagpur, C. P.,
October 10, 1933.

Physics of the "Smell".

PROF. BOHR in his recent address[1] on 'Life and Light' has emphasised the peculiar organisation of living beings with a view to understanding their essential characteristics. This organisation exhibits typical atomistic and quantum traits combined with the ordinary mechanical characteristics, in a manner having no counterpart in inorganic matter.

As an illustration of the refinement to which this organisation is developed, Prof. Bohr has considered the case of the human eye. The eye is an ideal and perfect optical instrument inasmuch as its resolving power and its sensitiveness have reached the limit imposed by the wave and quantum nature of light. It has been found that the eye can be stimulated by a few light quanta (or possibly a single light quantum ?). Further the optical resolving power [$(5/d^n)^n$ where d is the aperture of the eyelens in inches] and the physiological resolving power (angle subtended by the "cone" in the retina at the eyelens) of the eye are almost the same. This perfection of the eye naturally leads one to expect that the other organs also may reveal similar characteristics, the study of which will greatly help in establishing the relation between organic evolution and physics.

A consideration of the construction and function of the nose may also afford another interesting example. The human nose appears to be very sensitive to smell. However, physics corresponding to the sensation of smell does not exist at all, though physics of the eye and the ear (being simpler) has developed so much.

It is of interest to see whether the sensitiveness of the nose has also reached a

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[1] *Nature*, March 25 and April 1, 1933.

limit imposed by the atomic character of substances giving rise to the sensation of smell; *i.e.*, whether the sensation of smell can be excited even when there be present a few molecules (or a single molecule?) of an intensely smelling substance. Any data that might be obtained in this connection are bound to be helpful in the study of the evolution of senses. It is intended to make some tests on this point and we shall be glad to receive information on data concerning this if already obtained.

D. V. GOGATE.
D. S. KOTHARI.

Physics Department,
University of Allahabad,
Allahabad,
October 24, 1933.

A Gall-like Structure from a Tree in the Andamans.

WHILE on a visit to the small tidal creeks between the Cholunga range of hills on the west coast and the Sholl Bay creek on the east coast of South Andaman, I noticed a large number of these gall-like structures on the branches of *Carappa obovata* (Meliaceæ),[1] a medium-sized tree which appears to be a common element of the flora of the swampy banks of the small tidal creeks. The structures have a considerable range in size, the largest collected being over 24 inches in diameter (Fig. 1). The smaller ones are nearly spherical in shape while the larger ones are oblong or kidney-shaped. In colour and in form they resemble superficially the tubers of *Amorphophallus campanulatus*. These were at first mistaken for fruits of *Carappa obovata*, but on closer examination of the tree it was found that the gall-like structures were firmly attached to the branches by tiny roots issuing from the base of the former. Thousands of ants were found swarming on the surface making it difficult to collect the "galls". A vertical median section of the "gall" (Fig. 2) reveals

Fig. 1

One small and two large galls from *Carappa obovata*, both from the same tree.

Orchids and other epiphytic plants are also found on the same tree.

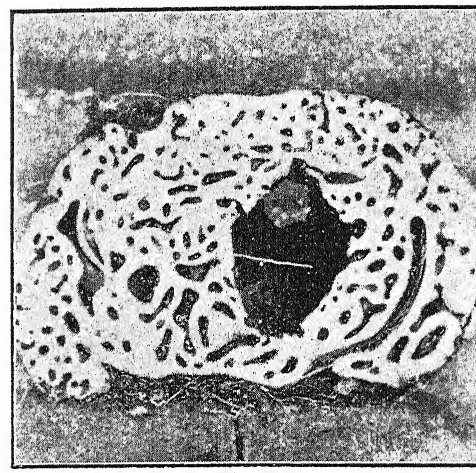

Fig. 2

Vertical median longitudinal section of one of the large galls showing the internal chambers.

a hollow space in the centre communicating with the outside by smaller apertures on the surface, and a number of more or less cylindrical passages which branch and anastomose to form a complex system of chambers resembling the interior of a termites' nest. The lining membrane of the chambers is of the same nature as that of the external surface of the "gall". The ants infesting the "gall" seem to breed and lay eggs inside the chambers. Mr. Durgadas Mukerjee of the Calcutta University who was kind enough to examine the ants has provisionally referred them to *Prenolepis bourbonica* Forel from which they differ in certain minor characters. He thinks, however, that they may prove to be a new race of *P. bourbonica*. The chambers are also inhabited by a few immature forms of

[1] I have to thank Mr. K. N. Ayyar, Extra Assistant Conservator of Forests, Port Blair, for identifying the plant.

other insects which are for the moment unidentifiable. The tissues of the "gall" are pith-like in consistency and are full of a watery secretion which seems to dry up very slowly; and it was found that the ants were alive and active for several days after the "galls" were removed from the tree.

It is difficult to say whether the structure described here is a true gall or not, and what the casual relationship of the ant to this structure may be. The presence of root-like structures on the undersurface of the "gall" inclines me to think that it may be an epiphyte like the orchids and other plants found in close association with it on the same tree, but the curious internal structure of the so-called gall appears to be unique. I hope to be able to collect more material with a view to further study.

H. SRINIVASA RAO.

Port Blair,
Andamans,
November 2, 1933.

Rhogas aligharensi sp. n. (A Pink Boll-Worm Parasite).

GOING round the cotton-fields at Aligarh in order to study the Pink boll-worm parasites, a few parasitised larvæ of Pink boll-worm (*Platyedra gossypiella*) were collected. From these larvæ some Hymenopterous parasites of the Family Rhogadinæ emerged out. These were studied and sent out for identification. Prof. Dr. Bischoff of the Universitaet Giessen a.d. Lahn (Germany) very kindly took the trouble of identifying them. He gave them a rank of new species belonging to the genus Rhogas. After a careful study they revealed close resemblance to a boll-worm parasite described from Lyallpore as *Rhogas testaceus* (Grav). The life-history which is very imperfectly worked out at Lyallpore resembles broadly with that of this new parasite found at Aligarh. Differences, however, exist in the structure. The chief points of difference are:—

(1) The number of joints in the flagellum of *R. testaceus* are 31–32, whereas in this Rhogas sp. there are 33–34 joints in the flagellum.

(2) Scape in *R. testaceus* is of a deep yellow colour while it is yellowish brown in these parasites.

(3) Abdomen in *R. testaceus* is yellowish brown ventrally but in these specimens the posterior segments are deep dark brown, especially in females.

(4) The size of females in some specimens was bigger than in *R. testaceus*. The ovipositor is black in colour.

From the field-study it appears that there is an external check on these parasites. In a few cases it was found that out of parasitised host larvæ, adult parasites failed to develop.

The biology and complete life-history of this parasite is under preparation and it will be published elsewhere.

MOHD. AFZAL HUSAIN QADRI.

Zoological Laboratories,
Muslim University,
Aligarh, U.P,
November 9, 1933.

On the Raman Frequencies of the NH_4-Group.

To explain the anomalous result observed in the Raman spectra of solutions of ammonium salts, in which the usual water band is found to be accompanied by another on the side of smaller frequency shift, we investigated the Raman spectra of a number of ammonium salts in the crystalline state and in the state of solution. It is found that the second band, wrongly attributed by some workers to water, is due to the NH_4 radical.

Microphotometric records of the spectra are taken to locate the position of the maxima in the NH_4 band. The following frequency shifts are obtained: $\delta\nu=3117$, 3169 (?), and 3220 Cm^{-1}. in the crystalline state; and $\delta\nu=3157$ and 3221 Cm^{-1}. in solution. These correspond to the infra-red absorption band found by Reinkober in ammonium salts at $3\cdot20\mu$. This band is attributed to the vibration of the N and H atoms parallel to the axis of symmetry in the pyramidal model of the molecule in which the N atom is situated at the vertex and the H atoms at the four corners of the base of the pyramid.

A detailed report of the investigation is communicated to the *Zeitschrift für Physik* for publication.

I. RAMAKRISHNA RAO.
C. SAMBASIVA RAO.

Andhra University,
Waltair,
November 15, 1933.

The Arc Spectrum of Tellurium.

THE arc spectrum of Tellurium has been investigated from the visible down to λ 1600 using an ordinary arc between Acheson Graphite poles containing pure Tellurium as source in the visible and quartz regions. Between λ 2000 and λ 1600 an arc in Nitrogen in the manner used by K. R. Rao,[1] has been photographed by a Vacuum Grating Spectrograph. The data obtained have led to the confirmation of the level scheme of TeI proposed by McLennan[2] and others and also to the identification of the combinations involving the 5d and presumably the sp^5 levels of the spectrum. The important intervals 5d $^3D_1$ -- 5d $^3D_2$ and 5d $^3D_2$ -- 5d $^3D_3$ are 196 and 789 cms^{-1} respectively. Adopting the value 72667[3] for the deepest term 5p $^3P_2$ of the spectrum a number of new low-lying energy levels 22624, 20800, 16997, 13923, etc., have been discovered. The detailed scheme will be published elsewhere.

S. GOPALAKRISHNA MURTY.

Science College,
Andhra University,
Waltair,
November 20, 1933.

On the Feeding Habits of *Belostoma indica.*

THE mode of feeding of this giant water-bug was observed in the Laboratory to elucidate certain points regarding its feeding habits. The bug measured three inches in length and one inch across the thorax. As is well known it floats on the surface of water and if submerged produces the anal tube for respiration.

Tadpoles of various sizes were supplied. Small tadpoles could not be held between the grooved fore femur and tibia partly owing to the small size of the animals and partly that any slight touch would dart them away. Frogs about one inch long and half inch wide were easily caught and held fast between the forelegs and the bug pierced its stylets up to the base at any soft place usually between the arm and belly and sucked out the fluid till the animal was flabby.

Efforts to get away on the part of small frogs were of no avail as the grip was very tight even so much that it was difficult to take the animal away with the forceps.

Larger specimens of frogs were later on supplied and in no case was the bug found feeding as has been described by Herbert Manners [1] or as is shown in the drawing by R. C. Wood. On the other hand such large specimens of frogs moved away or jumped, much frightened, on the approach of the bug.

Artificial attempt to feed on larger frogs revealed further that the skin in these was tough and slippery for the stylets to pierce and the bug left such specimens for want of successful feeding. Pieces of dissected tissue of frog were also caught by the fore legs and feeding was resumed.

Attempts to feed this bug on other aquatic Hemiptera (*Nepidæ*) and water-beetles (*Dytiscidæ*) were unsuccessful probably due to their hard exoskeletons.

U. S. SHARGA.

Entomology Department,
Agricultural College,
Cawnpore,
November 24, 1933.

A Cranial Abnormality in the Indian Mackerel—*Rastrelliger kanagurata.*

IN the normal cranium of this interesting fish, it will be noticed that there is an epiotic on either side of the supraoccipital and above the exoccipital. The epiotic has three outer surfaces—dorsal, lateral and posterior and is pointed postero-laterally. The dorsal surface of the bone sends antero-inwards a thick ridge which is continuous with a similar one from the supraoccipital and forms the upper edge of the posterior surface of the cranium. The lateral surface forms the inner wall of the temporal groove and the posterior surface contributes to the posterior wall of the cranium. The inner or the cranial surface of the bone has a small and a large recess. The two recesses are partly separated by a thin ridge, and are in continuation with each other at the base. The posterior semi-circular canal enters the wide recess and comes out of the bone through the smaller one.

In the specimen under consideration the left epiotic is absent and in consequence of

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[1] *Proc. Roy. Soc.*, **A. 124**, 465, 1929.

[2] *Phil. Mag.*, **4**, 486, 1927; also *Nature*, **124**, 874, 1929.

[3] Ruedy: *Phy. Rev.*, **41**, 588, 1932.

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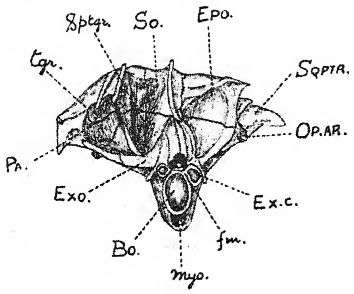
[1] Maxwell-Lefroy, H., *Indian Insect Life*, pp. 714-764.

this, considerable changes have taken place in the posterior region of the cranium. The supraoccipital bends considerably postero-laterally on the left side and articulates directly with the squamosopterotic and the exoccipital. The supratemporal groove on the left side has become very deep and extends even over the exoccipital. The exoccipital has developed a thin vertical ridge which is continuous with the ridge of the parietal forming the outer and inner



The Posterior View of the Abnormal Cranium of *Rastrelliger kanagurata*. (×2)

Bo.=Basioccipital. Epo.=Epiotic. Ex.c.= Exoccipital condyle. Exo.=Exoccipital. fm.= foramen magnum. myo.=posterior opening of the myodome. Op.ar.=Opisthotic articular facet. Pa.=Parietal. So.=Supraoccipital. sptgr.=supratemporal groove. Sqptr.=Squamosopterotic. tgr.=temporal groove.

walls of the supratemporal and temporal grooves respectively. The exoccipitals, with the foramen magnum, have slightly shifted to the right side. The articular condyle of the right exoccipital and also the articular facet of the right opisthotic (for the lower limb of the post-temporal) are more prominently developed than in normal crania. And the same structures on the other side of the cranium are ill developed. The cranium is being worked out in detail in this laboratory and a complete account is proposed to be published soon elsewhere.

M. JAYARAM NAIDU.
B. S. BHIMACHAR.

Zoological Laboratory,
University of Mysore,
Bangalore,
November 1933.

Hydro-Electric Schemes in India.

WITH reference to the letter of Dr. H. E. Watson on page 54 of the August issue of your *Journal*, the following information may be useful:—

I. It is true that other Power systems in India have adopted 50 cycles as the frequency; but Mysore has not been cut off from all co-operation with her neighbours on that account. On the other hand, Mysore has taken the lead and set an example in such co-operation. In the year 1928, the Government of Madras were considering various plants to put up a temporary Diesel Engine Power Station of about 4,000 E.H.P. to supply electricity to drive various machinery connected with the construction of the gigantic dam across the Cauvery River at Metur. The Government of Mysore considered this a suitable opportunity to help Madras and offered Cauvery Power from Sivasamudram at such a reasonable rate that the Madras Government abandoned their Diesel Engine Scheme and entered into negotiations with Mysore with the stipulation that electric power to be delivered to them must be of 50 cycles, 3-phase and 3,300 volts to suit their Transformers and Motors. A double circuit 63 mile High-tension Transmission line (35,000 volts) was built, and step-down plant was installed at Metur, which included suitable Frequency Changers to convert power from 2,200 volts, 25 cycles to 3,300 volts, 50 cycles. The system has been working satisfactorily for the last five years and has saved the Madras Government a few lakhs of rupees and incidentally benefited Mysore.

II. In the event of general Railway Electrification Mysore will have no special difficulties. The standard system for traction adopted by the G. I. P. and South Indian Railways is 1,500 volts D. C. and any power scheme with A. C. power of 50 cycles or 25 cycles has to install Rotary Converters or mercury arc rectifiers to convert A. C. power to D. C. just as the above Railways have done.

III. So far as Electric Power Machinery are concerned it is just as easy to obtain 25 cycle equipment as 50 cycle. The bigger machines are so special that they are built to order and it is only a matter of design to construct them for 25 cycles. Small size Motors and Transformers of 25 cycles have been standardised by the bigger Electrical Manufacturers of the world and they are easily available.

IV. People at Sivasamudram and Kolar Gold Fields have been using 25 cycle power for lights for the last 31 years, and their eye-sight is as good as ever. In these days

when frosted lamps are available at the same rates as ordinary lamps, the flicker effect is also eliminated. The Cities of Bangalore and Mysore are provided with higher frequency power for lighting purposes by the installation of frequency changers. In course of time other centres may also be equipped with frequency changers when conditions are favourable. The Government of Mysore and their Engineers are in touch with the latest developments in the field of Engineering and their Power Stations are equipped with up-to-date apparatus. Whatever useful measures are necessary are generally carried out even if they involve heavy expenditure. But even in Europe and America Frequency standardisation does not always mean the entire changing over of all the machinery in a long-established 25 cycle system. By suitable frequency changers they have linked the 25 cycle systems with 50 cycles, keeping the expenditure within reasonable limits. There are possibilities in the near future of the use of "Inverters" for changing from one system to another and Mysore will not lag behind in carrying out such modifications in the Power Scheme as are found necessary and useful.

B. K. RAM PRASAD.

Power Station,
Sivasamudram,
November, 1933.

On the Statistical Theory of Solutions.

IN a recent paper Guggenheim[1] claims to have derived thermodynamical formulæ for solutions by the application of Fowler's statistical method, without assuming the validity of the gas laws. He, however, uses the relation $F = E - TS + PV$ which is only true if gas laws are applicable to solutions. In the present note we shall indicate a more straightforward method, based on generalised Gibbs' statistics[2] for obtaining some common thermodynamical relations for solutions.

Consider a system of n components capable of existing in the vapour and the liquid phase. The volume in the liquid phase $V = V^*$ (1-rep) where again $V^* = N_A V_A^* + N_B V_B^* + ..$ V^* being the total volume at very low pressure, V_A^*, V_B^* etc. being the same per molecule of a^{th}, b^{th}....types. N_A, N_B.... are the number of these molecules and n the compressibility. The volume due to i^{th} kind of molecules

$$V_i = \frac{N_i V}{N_A + N_B + \ldots + N_n} \quad .. \quad (1)$$

assuming no interaction.

In the liquid phase the volume is taken to be practically constant. We then have the familiar equations of classical statistics

$$N_i = \frac{V}{h^3} \int e^{\frac{\psi_i - u_i - \omega_i}{kT}} \Delta T_p$$

$$= \frac{(2\pi m_i kT)^{3/2}}{h^3} V \cdot e^{\frac{\psi_i - \omega_i}{kT}} \quad .. \quad (2)$$

(For liquid phase)

$$N_i' = \frac{(V' - b)(2\pi m_i' kT)^{3/2}}{h^3} e^{\frac{\psi_i'}{kT}} \quad .. \quad (3)$$

(For gaseous phase)

b being Van der Waal's correction and ω_i the additional work term for the liquid phase (corresponding to heat of solution). For equilibrium

$$\psi = \psi' \quad .. \quad .. \quad .. \quad (4)$$

Substituting $p_i = \dfrac{N_i' kT}{V - b}$ and using p_i° for the pressure when only the i^{th} kind of molecules are present, we have from (1), (2), (3) and (4)

$$p_i = p_i^\circ \frac{V_i}{V} = p_i^\circ \frac{N_i}{N_A + N_B + \ldots + N_n} \quad (5)$$

which is the generalised form of *Raoult's Law.*

Again using the relation $\dfrac{d\psi_i}{dp} = V_i$ (6)

and considering osmotic pressure to be the difference of pressure due to the solution and pure solvent in equilibrium we have

$$\pi = (\psi_i - \psi_i^\circ)/V_i$$

$$= \frac{kT}{V_i} \log \frac{N_A + N_B + \ldots + N_n}{N_i} \quad .. \quad (7)$$

which is the generalised formula for *osmotic pressure.*

For imperfect solutions N_i is to be everywhere replaced by $N_i f_i$, f_i being the activity coefficient.

Henry's Law.—From (2), (3) and (4) we have

$$\frac{N_i}{V} = c_i = kp_i \quad .. \quad .. \quad .. \quad (8)$$

where $k = \dfrac{1}{kT} e^{\omega_i/kT}$, and N_i is the number of gas molecules present in solution.

---

[1] Guggenheim, *Proc. Roy. Soc.*, **A 135**, 181 (1932).

[2] Kar and Mazumdar, *Z. Phys.*, **55**, 546 (1929); also Kar and Ganguli, *ibid.*, **62**, 5101 (1930).

Nernst's Distribution Law.—We consider an equilibrium of a solute A in two miscible liquids B and C. We then have corresponding to (2),

$$N_{A_1} = [N_A]_B$$

$$= \frac{(2\pi m_{A_1} kT)^{3/2}}{h^3} \cdot V_1\, e^{\frac{\psi_{A_1} - \omega_{A_1}}{kT}} \quad \ldots \quad (9)$$

$$N_{A_2} = [N_A]_C$$

$$= \frac{(2\pi m_{A_2} \cdot kT)^{3/2}}{h^3}\, V_2 \cdot e^{\frac{\psi_{A_2} - \omega_{A_2}}{kT}} \quad \ldots \quad (10)$$

Now since $\psi_{A_1} = \psi_{A_2}$ we have

$$\frac{N_{A_1}/V_1}{N_{A_2}/V_2} = \frac{c_1}{c_2} = e^{\frac{\omega_{A_2} - \omega_{A_1}}{kT}} = \text{const.} \quad \ldots \quad (11)$$

If, however, the molecules of A are associated in one of the solvent say C, we have instead of (10)

$$N_{A_2} = \frac{(2\pi m_{A_2} kT)^{\frac{3n}{2}}}{h^3}\, V_2 \cdot e^{\frac{n(\psi_{A_2} - \omega_{A_2})}{kT}} \quad (10a)$$

when n is the number of molecules associated to form a single molecule. Again equating the free energies we have

$$\frac{c_1}{c_2^{1/n}} = e^{\frac{\omega_{A_1} - \omega_{A_2}}{kT}} = \text{const.}$$

A. GANGULI.

Chemical Laboratory,
College Dupleix,
Chandernagore,
November, 1933.

Oogenesis of *Clibanarious olivaceus* (Henderson) with special reference to a seasonal variation in the various Cytoplasmic Inclusions.

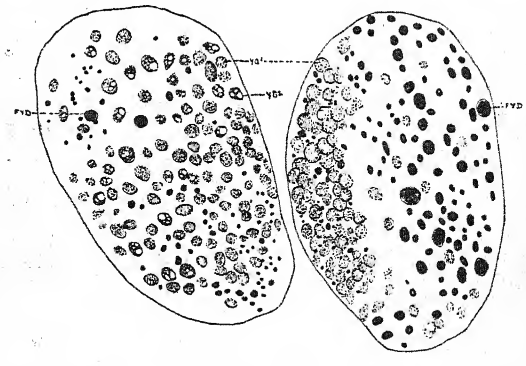
ALMOST all modern work on cytoplasmic inclusions has been done without any reference to environment and no two workers on the same animal have come to identical conclusions. In the case of Patella, Ludford states that the breeding season is in *autumn* and Brambell who studied the eggs of the same animal during the *winter months* has noticed some differences in the chemical composition of the various inclusions, though in the main his results corroborate those of Ludford. Hence, thinking that a study of the cytoplasmic inclusions in Clibanarious from oocytes collected during two different seasons, by all modern cytological methods such as Da Fano, Champy, Bensley-Cowdry, Nassonov, and Mann Kopsch and treatment of eggs in the fresh condition with neutral red, Janus Green. B, Sudan III, Scharlach. R and 2% Osmic acid, was well worth attention, such a study was made during two periods January-February and April-June 1933. A study of the physico-chemical factors, such as, Temperature, Excess Base, pH, Salinity and Chlorine content of the medium was also made.

The Golgi apparatus occurring as an irregular mass in both sets of preparations was seen to break up and give rise to granules which exhibited three different kinds of behaviour. (1) Some of them enlarged into vacuoles and secreted fatty yolk inside their interiors. (2) Some others enlarged into clear vacuoles with chromophilic rims, which by rupture gave rise to Golgi batonettes. (3) Lastly, in April-June preparations some of the Golgi grains metamorphosed into albuminous yolk.

The albuminous yolk consists of two kinds and from the nature of their origin they can be termed Golgi-mitochondrial and Golgi-Golgi albuminous yolk grains.

The former is seen in both sets of preparations. The initial mitochondrial cloud resolves itself into discrete granules which form a concentration at one pole of the egg. Masses of mitochondria clump together and in association with Golgi batonettes give rise to Golgi-mitochondrial albuminous yolk grains.

2. Apr.—June. **1.** Jan.—Feb.



Nassonov. × 110. Mann Kopsch.

FYD. = Fatty Yolk Droplet.
YG¹. = Golgi Mitochondrial alb. yolk.
YG². = Golgi-Golgi alb. yolk.

In April-June when fatty yolk droplets are smaller in size and few in number the

unmodified Golgi form a concentration below the mitochondrial polar concentration. These granules also clump together—each being constituted by 6-12 grains—and later become metamorphosed into albuminous yolk. The Golgi batonette which attaches itself retains its identity and condenses in addition nucleolar matter dissolved in the cytoplasm.

A seasonal change in the metabolism of the oocyte was observed and it was found that when the bar was open, with consequent increase in salinity, fatty yolk droplets occurred in large numbers (Fig. 1 FYD) and in April-June when the bar was closed—the salinity becoming correspondingly low—a very large amount of albuminous yolk—Fig. 2 Yg²Yg—was observed.

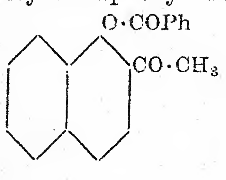
M. K. SUBRAMANIAM.
University Zoological
Laboratory,
Madras,
December 1933.

Ludford, Reginald James, "Contributions to the Study of the Oogenesis of Patella," *Jour. Roy. Micr. Soc.*, 1921.

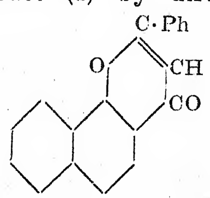
Brambell, F. W. R., "Origin of Yolk," *Brit. Jour. Expl. Biol.*, **1**, 1924.

A Synthesis of Flavones at Room Temperature.

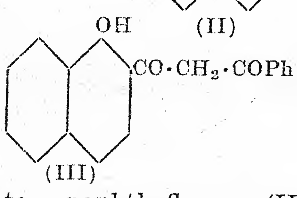
DURING an investigation[1] of the action of acid anhydrides on phenolic ketones Chadha and one of us[2] attempted to convert 2-acetyl-1-naphthyl benzoate (I) by direct



(I)

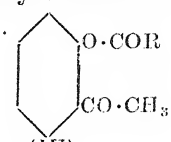


(II)

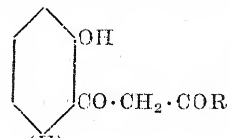


(III)

ring closure to α-naphthaflavone (II) with the two-fold object of testing the commonly assumed mechanism[3] of the Robinson reaction and of evolving a method of chromone synthesis which would preclude 3-acylation[4]. The action of sodamide on (I) in either solution has now led to ω-benzoyl-2-acetyl-1-naphthol (III); the mixture was left to stand overnight at room temperature (below 16° throughout), the bulky precipitate being then collected, washed with ether and decomposed with aqueous acetic acid. Treatment of (III) with cold concentrated sulphuric acid in the usual manner gave α-naphthaflavone (II). A smooth synthesis of a flavone has been accomplished below 16°; and the phytochemical significance of this reaction



(IV)



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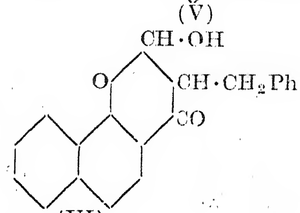
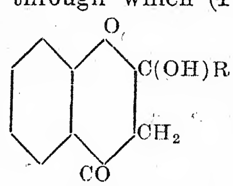


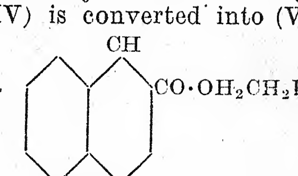
(VI)

and its possibilities for the synthesis of natural colouring matters of the flavone group are obvious.

A complete theory of the mechanism of the acid anhydride method of chromone synthesis has been advanced by Baker[5], who has achieved the transformation of *o*-acyloxyacetophenones (IV) to the dibenzoylmethanes (V) by means of potassium carbonate in toluene at the temperature of the steam-bath during a few hours in yields of 20—40% of the theoretical or at 35° in a yield of 24% after fourteen days. A compound (VI) similar to the 2-hydroxyflavanone (VII), postulated by Baker as the stage through which (IV) is converted into (V),



(VII)



(VIII)

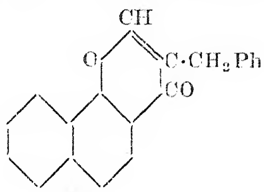
[1] Venkataraman, *J. Indian Chem. Soc.*, *Ray no.*, page 27.

[2] Chadha and Venkataraman, *J. Chem. Soc.*, **143**, 1073, 1933.

[3] Wittig, Baugert and Richter, *Ann.*, **446**, 155, 1925.

[4] Bhullar and Venkataraman, *J. Chem. Soc.*, **139**, 1165, 1931.

[5] Baker, *J. Chem. Soc.*, **143**, 1381, 1933.



(IX)

has been described by Cheema and Venkataraman[6], who isolated it from the products of the interaction of 2-benzylacetyl-1-naphthol (VIII), ethyl formate and sodium. On heating (VI) with acetic anhydride or alcoholic sulphuric acid 3-benzyl-α-naphthapyrone (IX) was obtained.

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December 4, 1933.

Cytoplasmic Inclusions in Acentrogobius Neilli (*Gobius neilli.* Day).

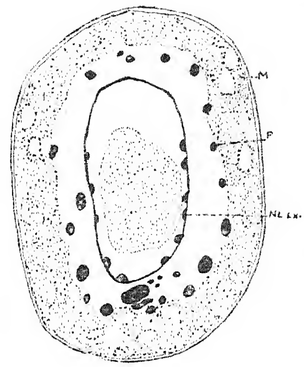
Cytoplasmic inclusions in Invertebrates have been worked out by a number of authors but workers on Vertebrate oogenesis seem to be few. Fish eggs have been studied by Hibbard and Parat, Eggert, Nath and a few others.

Acentrogobius neilli (*Gobius neilli.* Day), a common brackish water form in Madras, was studied by examination of fixed preparations as well as of fresh oocytes before and after treatment with solutions of neutral red, Janus Green.B, Scharlach.R, Sudan III and Osmic Acid 2%.

The mitochondria were studied from Champy, Bensley-Cowdry, Nassonov and Mann Kopsch preparations and for a study of the Golgi in addition to the last-mentioned technique Da Fano's silver impregnation method was also employed.

The mitochondria occur as a dense cloud of granules immediately surrounding the nucleus. With the growth of the oocyte they seem to move almost in the form of a ring away from the nucleus leaving a fairly clear space round the nucleus. They multiply quickly and soon occupy the whole area of the cytoplasm. They are not observed to take part in deutoplasmogenesis.

The Golgi apparatus occurs as an irregular mass just touching the nuclear membrane. This breaks up and moves into the surrounding cytoplasm in the form of granules. Later they seem to be associated with fatty yolk globules.



Mann Kopsch Allman.
Young Oocyte. ×325.
M.=Mitochondria.
F.=Fat.
NLEX.=Nucleolar Extrusions.

Fat and fatty yolk both occur in the egg. Fat seems to arise from nucleolar extrusions. Fatty yolk probably arises by condensation of material by the Golgi apparatus.

A perusal of the literature on cytoplasmic inclusions will show that the term *fatty yolk* has been used to mean both yolk with a large quantity of fatty or lipoidal material (Ludford) and also for fat not miscible with the general cytoplasm (Nath). Actually there appears to be more than two kinds of deutoplasmic inclusions *fat*, *fatty yolk*, and *yolk* in eggs and it is proposed to discuss this matter more fully in a future communication.

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R. Gopala Aiyar.

University Zoological
Laboratory,
Madras,
December 1933.

Hibbard, Hope and Parat, M., "Oogenesis of certain Teleosts," *Jour. Anat.*, **61,** 1927.

Eggert, Brune, "Entwicklung und Bau der Eier Von Salarius flavo-umbrinus Rupp," *Zool. Ann.*, Bd. **8,** 1929.

Nath, V. and Nangia, M. D., "A demonstration of the Golgi Apparatus and the vacuome as independent components in the fresh eggs of Teleostean Fishes," *Jour. Morph.*, **52.** 1931.

Nath. V., "Microchemical Tests: fats, lipods and vacuoles with special reference to Oogenesis," *Quart. Jour. Micr. Sci.*, June 1933.

Ludford, R. J., "Contributions to the Study of the Oogenesis of Patella," *Jour. Roy. Micr. Soc.*, 1921.

[6] Cheema and Venkataraman, *J. Chem. Soc.*, **141,** 918, 1932.

Electrical Resistance of Gel-forming Mixtures during Setting.

HURD AND SWANKER in a letter to the Editor (*Journ. American Chemical Society*, June, 1933), have reported that the electrical resistance of gel-forming mixtures containing solutions of sodium silicate and acetic acid of various concentrations, undergo no change during the process of setting.

Prasad and Hattiangadi (*Journ. Indian Chem. Soc.*, **6**, 893, 1929) had observed that the pH (determined colorimetrically) of the alkaline gel-forming mixtures containing sodium silicate and acetic acid increases during the process of gelation. With an expectation that some consequent changes in the electrical conductivity of the gel-forming mixtures would take place during the process of gelation we undertook to measure the electrical resistance of the gel-forming mixtures containing solutions of various concentrations of sodium silicate and of acetic and citric acids in February 1932. Our results were in agreement with those now reported by Hurd and Swanker that the electrical resistance of a gel-forming mixture does not change during gelation.

R. K. UPADHYA.
MATA PRASAD.

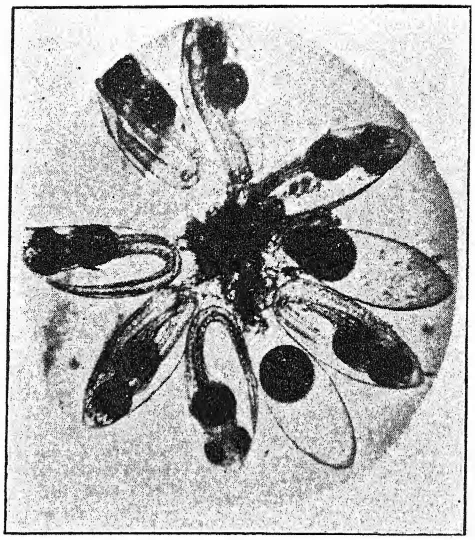
Royal Institute of Science,
Bombay,
December 1933.

Preliminary Observations on the Life History of Acentrogobius Neilli (*Gobius neilli*. Day).

SPECIES of Gobius are essentially shore forms and many are found in brackish and fresh waters. The eggs and life-histories of several forms of this genus have been described by Guitel, Holt, Petersen and Lebour, to mention a few. Their accounts mostly deal with the nature of the eggs and the time of their occurrence. *G. minutus*, *G. microps*, *G. pictus* and *G. ruthensparrii* have had their life histories more fully worked out by Lebour and Petersen. Gobius usually attaches the eggs to shells of Lamellibranchs such as Pecten, Ostrea, Mya, Cardium, and often to the shell of Patella. The breeding months near Plymouth seem to be April, May and June. Hatching takes place in about a fortnight and a free swimming larva about 3 mm. long without pelvic fins emerges. Very little is known about the life histories of the forms occurring in India. Several stages of *G. ostreicola* were described by Bhattacharya from preserved material from the Chilka Lake.

Gobius neilli occurs in large numbers in the brackish waters of Adyar and grows to 3¼ inches. They begin to breed when they are 20 mm. long. Mature females can be obtained in enormous numbers just before the monsoon. A few days after commencement of the monsoon most of them are found to have spawned. Developing stages were obtained by artificial fertilisation.

Almost immediately the outer cover of the egg swells up into a club-shaped structure. The micropyle comes to be placed at the



narrow end of the club through which mucilaginous threads flow out and anchor the egg case to the substratum. The case itself is packed with a jelly like material in the centre of which the embryo undergoes its development.

Within 32 hours after fertilisation the Head, Eye Vescicles, Notochord and Brain are established.

The embryo begins to rotate in a longitudinal axis in the egg case from the middle of the second day and hatches out as a free swimming fry at the beginning of the third day of development (72 hours). The process of hatching is interesting and is executed by the embryo breaking open one side of the egg case near the free end. Further development has been followed up to the eighth day.

The time taken for hatching is very much less in this form than in those described by Lebour and can only be attributed to the

smaller size of the eggs (0·4 mm.) in *G. neilli* and also to the great difference in temperature conditions being 14°C. near Plymouth and 25°C. in Madras. Orton and others have drawn attention to the effect of temperature on the breeding of several marine animals.

R. GOPALA AIYAR.

University Zoological Laboratory,
Madras,
December, 1933.

Bhattacharya, D. R., "Stages in the Life History of Gobius, Petroscirtes and Hemirhamphus," *Mem. Ind. Mus.*, Chilka Lake, **5**, No. 4.

Guitel, F., "Observations sur les. Mœurs de Gobius minutus," *Arch. Zool. Paris*, **10**, 2, 8, 1892.

Holt, E. W. L. and Scott, S. D., "A record of the Teleostean eggs and larvæ observed at Plymouth in 1897," *Jour. Mar. Biol. Assn.*, N. S., **5**, 1897-99.

Lebour Marie, V., "The young of Gobiidæ, from the neighbourhood of Plymouth," *Jour. Mar. Biol. Assn.*, **12**, 1919-22.

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Peterson, C. G. J., "On the Eggs and Breeding of our Gobiidæ," *Rep. Danish Biol. Stat.*, **2**, 1891-92.

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Research Notes.

Intra-cellular Inclusions in Tobacco Ring-Spot.

THE list of plants affected by viruses or ultra-microscopic organisms is quite large extending to a large number of species. Of these, only in a few cases, the diseased cells are characterised by the occurrence of intra-cellular inclusions. The latest addition to this group is the ring-spot of tobacco which has been re-examined by Woods (*Contr. Boyce Thompson Inst.*, 5, 419, 1933), who has established the presence of such bodies in plants infected under green-house conditions. These are found to occur in all cases of primary lesions in the several varieties of tobacco studied. In the case of *N. tabacum*, however, they were present where the lesions were systemic. Ring-spot disease is also observed to affect *Petunia* sp. where a similar observation has been made.

The occurrence of these inclusion bodies has been investigated with particular reference to structure, position in the cells, and distribution in the affected leaves. The bodies are always found in association with the nucleus. Non-lesioned areas did not show any such body in them. In the lesioned spots, the cells in the central portion had a greater number of bodies than those in close proximity to the necrotic areas. In these cases, the cells appear to have undergone considerable disintegration. Where the bodies were present, the cells containing them did not show visible signs of degeneration. But the development of the bodies could directly be correlated with the formation of visibly lesioned areas in the leaf.

In an affected plant, the growing point and tender shoots, although they showed partial necrosis, did not contain the bodies. As a rule, the oldest and largest cells contained them. The occurrence of these is more easily traceable to the metabolic condition of the cell at the time of inoculation, rather than to the lapse of time during which the virus remains in the cell. The bodies were generally observed to be vacuolated. Besides the vacuoles, certain other inclusions were detected within the bodies chiefly, the red staining cuboidal bodies. From the manner of their occurrence in the cell cytoplasm also, the author imagines them to be protein crystals.

The state of aggregation of substances in the diseased cells, lend the view that these vacuolated inclusion bodies represent an accumulation of certain materials in the cytoplasm. In a few instances of primary lesions the bodies were noticed to have a membrane-like periphery. The appearances and staining reactions reveal a striking resemblance to masses of young cytoplasm.

The study is important from the point of view of the origin and development of the intra-cellular inclusion bodies characteristic of virus diseases of plants. V. I.

Discovery Reports—Sponges.

IN the "Discovery Reports" (Vol. VI, pp. 239-392, plates xlviii-lvii, 1932) issued by the Discovery Committee, Colonial Office, London, Maurice Burton of the British Museum (Natural History) has given an exceedingly interesting account of the

Sponges collected during the years 1925-1929 by the R. R. S. 'Discovery' and the R.R.S. 'William Scoresby' in the course of their cruise in the South Atlantic Ocean, and by the staff of the Marine Biological Station at South Georgia. The collections include representatives of 168 species and varieties of which only 35 are new. The descriptive part of the account is preceded by a systematic list of the species under report and a list of the stations with the names of species collected at each. It is impossible within the short space of a review to refer to all the points of interest raised and discussed by the author, but the more important ones, such as the correlation between the distribution of Sponges and the main surface currents of the oceans, the embryonic development and its value in systematic study, and the significance of external form in the identification of Sponges, may be referred to in the briefest manner possible.

To the beginner in the systematic study of Sponges, confused by the bewildering multiplicity of genera and species based not infrequently on worthless characters, discernible only by their authors, the present report seems to hold out a promise that on a careful study of a large number of specimens of the various species from one or more localities, the number of the so-called genera and species will be reduced, in the not distant future, to an extent that will prove an inducement for more extended study of this group. The author's remarks in the systematic account under *Isodictya setifer* (Topsent), *Amphilectus fucorum* (Esper), *Iophon proximum* (Ridley), and *Tedania massa* (Ridley and Dendy) seem to justify this statement.

In the section on Geographical distribution the author dilates on the controversial but highly interesting hypothesis that despite the barriers set up by temperature the main oceanic currents act as the agents of distribution of Sponges, and that transportation by currents may possibly happen in the post-larval stages of some species, at any rate, when the young Sponges, in most cases, are in the form of thin incrustations on floating objects. The fact that some species of Sponges are common to both Australia and the West Indies, and to the west coast of Africa and the Indian Ocean seems to support this hypothesis. He then goes on to describe the two well-defined areas of distribution each with its distinctive fauna—the Indo-Pacific *cum* Indian Ocean, which he terms the Indian Ocean area, and the South Atlantic area including the portion below a line approximating to the equator, both with their practically closed systems of currents, and how at the meeting point of the warm Agulhas and the cold Benguela currents south of the Cape of Good Hope, and of the warm Brazilian and the cold Magellan currents on the South American coast at a line level with Beunos Aires, effective temperature barriers are formed which prevent a general mixing of the species in the two well-defined areas. While, as pointed out above, some species common in the Indian Ocean area are also found on the west African coast and in the West Indies, no species of the South Pacific area are found in the S. Atlantic beyond the Beunos Aires barrier. This fact shows that while in one case the temperature barrier is incomplete, in the other it is complete. In the author's opinion a more important deciding factor in the matter of distribution is the relation of the two currents which constitute the barrier, that is to say, whether the currents running in opposite directions do really oppose as in the case of the Beunos Aires barrier, or only run parallel to each other as in the Cape of Good Hope barrier. In the latter case the migration of species from the Indian Ocean area to the West Indies through the S. Atlantic along the west coast of S. Africa following the flow of the Benguela current, and thence into South Equatorial becomes intelligible. So far as the Sponge fauna of the S. American coast is known, no species south of the Beunos Aires barrier is found north of it. The author's explanation for the completeness of this barrier is both ingenious and plausible. "Since the currents are opposed, any mixing that may take place is nullified by the fact that the cold current from the south encounters and passes under the Brazilian current, continuing its journey northwards beneath the surface. In this way any floating bodies reaching the northern current will be restored once again to the warm surface waters of the South Atlantic." It is refreshing to note that the author has an open mind on the subject, and emphasises the need for a thorough test of his hypothesis by extensive observations in other parts of the world, not merely for Sponges, we hope, but for other groups of the marine fauna as well.

In the section on the embryonic development of Sponges the author points out the possible value of the embryos (at least in preserved material) to the systematist, and

proceeds to describe the embryos of some species of *Tedania* with clear sketches of all the stages found, and of several species belonging to various other genera. On pages 342-345 of the report this point is greatly elaborated in reference to the species of *Tedania* which amply justifies the author's faith in embryological data as the "deciding criterion in systematic work". It is to be hoped that the lead given by him in this respect will be followed by other workers on the group.

In another section of the report (pp. 375-378) the value of external form in the identification of Sponges is referred to, and the various criteria on which identification of Sponges is based are critically examined. According to the author, the most reliable guide for the diagnosis of families is the categories of spicules present, for that of genera, the arrangement of the various elements of the skeleton with minor variations in shape, and for that of species, the external form with minor variations in the arrangement and categories of spicules present. The role of environmental factors in determining the shape of a Sponge should not, however, be overlooked, and in the description of Sponges details of habitat and associations are a great help in judging the precise limits of a species. Much of the confusion in systematic Spongology can be avoided by careful and adequate descriptions of species from entire Sponges, with due attention given to the variation in the shape and size of spicule categories, and to the external form. The author's remarks on these points deserve a careful study.

H.S.R.

Secretion of the Pancreas and Salivary Glands.

E. S. DUTHIE (*Proc. Roy. Soc. Lon.*, **B. 114**, No. 786) has extensively examined the behaviour of the cytological constituents and their relation to secretory activity in pancreas and salivary glands. Confining his studies to the mouse and frog, the author determines the value of mitochondria and golgi in secretion in these two types of glands. In the pancreas observations on living cells by the intra-vitam method of staining have revealed the origin of the zymogen granules in relation to mitochondria. The migration of these granules towards the golgi area has been actually observed in living cells. Contrary to the views of Parat the vacuome has no relation to the golgi body. In the salivary glands the conclusions of the author have been largely deductive. The occurrence of the secretory granules at the base of the cells and away from the golgi area has led the author to think that the granules arise in relation to the mitochondria. The account mostly confirms the conclusions of Hirsch. Stimulation of cells is seen to produce fat granules in both kinds of cells, probably as a result of the disintegration of the mitochondria.

Rains of Fishes in India, with a Note on their Meteorological Aspects.

THE following is a summary of an interesting paper read by Dr. S. L. Hora before the ordinary monthly meeting of the Asiatic Society of Bengal held on the 4th December.

In the *Statesman* of the 14th of September, 'Kim' published a short note on three rains of fishes in the Muzaffarpore District. The information was supplied to him by an eye witness, Mr. G. T. Gill of the Bhicanpur Factory. Kim's note was followed up by the author with the result that a great deal of valuable information has been collected through Kim's numerous correspondents, some of whom supplied information direct to the author. Since the 15th of September the *Statesman* has been publishing accounts of rains of fishes from time to time and it would seem that the phenomenon is still regarded by the general public with scepticism and that any explanation showing fish falling from the sky is considered a myth.

The first two records of rains of fishes in India were published in 1833 in the *Journal of the Asiatic Society of Bengal* by James Prinsep, the celebrated Secretary of the Society, and upto the present time 10 instances had been recorded, the last being in 1852 at Poona. It is undoubtedly true that every fall of fishes that occurs is not recorded, but the phenomenon is sufficiently unusual and striking to have attracted the attention of a number of people. Kim's column in the *Statesman* has unearthed several such records which would have passed unnoticed otherwise. The author gives particulars of the Rains of Fishes hitherto recorded from India, including those that fell during this year, and mentions

the species of fish known to have fallen with rains in India. The kinds of fishes that rained in Muzaffarpore in July and August last will be exhibited and attention will be directed to their mode of life, etc.

Five explanations of the rains of fishes have been advanced, namely, (i) hatching out of eggs after heavy rainfall; (ii) fishes wrongly supposed to have fallen with rain might have been migrating overland from one stream or pond to another; (iii) fishes might have been left behind by overflows after heavy floods; (iv) fishes may have been æstivating and have been awakened by the coming of the rain; and lastly (v) the rains of fishes are due to the action of heavy winds, whirlwinds, and waterspouts. All these explanations are discussed by the author and it is indicated that the only explanation tenable is that of whirlwinds and waterspouts. The popular belief of the people of northern Behar regarding waterspouts is given, and in his note Dr. S. N. Sen, Meteorologist at the Alipore Observatory, has shown how waterspouts may be formed in India and by analyzing the meteorological conditions on the two days of occurrence of the rains of fishes in the Muzaffarpore District has shown that during those days the weather conditions were most favourable for the formations of waterspouts over that area. Several other meteorological problems regarding the falls of fishes in India are also discussed.

The Theory and Practice of Drying.

UNDER the joint auspices of the South Indian Science Association, Bangalore, the Society of Biological Chemists, India and the Indian Chemical Society (Madras Branch), an interesting discussion on the "Theory and Practice of Drying" was held on Sunday, the 12th November 1933, in the Central College Chemistry Lecture Theatre, Professor H. E. Watson of the Indian Institute of Science, presiding.

In the course of his opening remarks, Dr. Watson drew attention to the great importance of drying in science and industry. In a tropical country such as India where plenty of sunshine was available, and industries were not highly developed, the problem had not received as much attention as it had in those places less favourably situated, since sun-drying sufficed for many purposes. This simple process, however, was apt to become impracticable when large quantities of material had to be handled and in many cases contamination by dust would render a product unmarketable. It was essential therefore to pay attention to more complicated methods.

Although the theory of drying was similar for all materials, in practice there were wide differences in the methods of treatment. In the first place the temperature to which the material might be subjected was of importance. At one end of the scale were found substances which might be raised to a red heat without deterioration and at the other those which had to be dried at a temperature not exceeding that of the body. A second consideration was the physical nature of the material. With goods such as textiles, the rate of drying depended almost entirely upon the quantity of hot air or other drying agent which could be supplied, while with clays diffusion in the material itself was the controlling factor. In addition to these general considerations a special technique was required in many cases and thus it was evident that the problem was one of great complexity.

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THEORY OF DRYING—I. *M. A. Govinda Rao.*—When solids of appreciable thickness are dried, the moisture must, by some mechanism or other, travel from the interior out to the surface before it can escape into the surrounding drying medium. This mechanism determines the particular variables which govern the rate of drying and the quality of the product.

Materials of fibrous or colloidal nature when brought into contact with air of definite temperature and humidity, will dry up only to a limiting moisture content, known as the "equilibrium moisture content" or 'regain'. It is just the moisture content in excess of this value that is capable of being removed by drying.

If we start with a wet solid, under steady drying conditions, the rate of drying at first remains constant and then falls off. The rate at which moisture can evaporate from a continuous film of water on the solid surface, determines the constant rate of drying, and to a certain extent also the rate during the initial stages of the falling-rate period, until the surface of the solid reaches the equilibrium moisture content. Thereafter the velocity with which water can diffuse outwards from the interior of the solid, determines the drying; the rate of diffusion, and hence of drying, falls off with decreasing average moisture content, or in other words, with decreasing average concentration difference through the solid. During this diffusional stage in drying, neither decreasing the humidity of the drying medium, nor increasing its velocity, will speed up the drying process. T. K. Sherwood (*Trans. Amer. Inst. Chem. Eng.*, **27**, 90, 1931) and A. B. Newman (*Ibid.*, **27**, 203, 310, 1931) have developed equations for calculating the rates of drying for different solid shapes and have represented them in the form of simple curves.

When a wet solid is drying at constant rate, moisture gradients are set up in the interior of the solid. The magnitude of these gradients is of immense importance in the drying of materials which tend to warp or crack. A differential moisture content in the body of the solid causes a differential shrinkage, which must be prevented from becoming dangerously large. E. R. Gilliland

and T. K. Sherwood (*Ind. Eng. Chem.*, **25**, 1134, 1933) have very recently developed equations from which the true moisture distribution inside a slab can be computed at different intervals of drying at a constant rate.

Although all the equations that have been derived are in fairly close agreement with experimental data, the actual mechanism by which the water travels up to the surface is not still properly understood. In several cases the water may evaporate before it reaches the surface; how this factor influences the moisture distribution is a problem requiring further elucidation.

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THEORY OF DRYING—II. *K. R. Krishnaswami.*—Careful control is essential in the drying of crystalline materials with a view to prevent loss of water of crystallisation. Drying in absence of air with the aid of superheated steam, is a process of great utility in dealing with certain classes of substances.

The period necessary for the operation of drying depends upon the area of surface exposed and wherever possible, attempts are made to reduce the material to a fine state of subdivision; where however such reduction in size is not permissible, the drying would be an extremely slow process. Attempts to speed up the process will only result in unequal drying which leads to the production of unsuitable articles; such instances are to be particularly found in the glass and ceramic industries.

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INDUSTRIAL DRYING EQUIPMENT—I. *S. K. Kulkarni Jatkar.*—Sticky and plastic substances, pastes and precipitates are dried in compartment driers provided with devices for circulating hot air over and between the trays containing the material. Substances which are sensitive to heat are treated in a vacuum compartment drier, the material being spread in thin layers on the heated shelves. Tunnel driers are employed when large quantities of materials have to be dried, the material being conveyed on cars continuously with counter current circulation of hot air.

Granular and crystalline materials are dried in rotary driers. The material is fed at the high end of a cylindrical shell directly or indirectly heated with its axis set at an angle to the horizontal and mounted on rollers. The rotation of the drier and the internal flights advance the material to the lower end in showers which meet the counter-current hot air. Sticky materials are handled in mechanically agitated driers of either atmospheric or vacuum type.

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INDUSTRIAL DRYING EQUIPMENT—II. *L. Gopala Rao.*—The simplest form of dryer, whose field of application is however limited, consists of a series of travelling endless belts, on to which the material is suitably fed and dried by passing dry, hot air in counter-current. The use of this dryer for drying chilled soap direct from the kettle has resulted in eliminating the tedious intermediate operations of cooling in moulds, slabbing, cutting and chipping and, particularly, reduced the time from several days to fifteen minutes. Where the material is sensitive to heat, the dryer is enclosed in a special vacuum chamber and the bands slide over steam or water-heated plates which supply the necessary heat.

A common device applicable to various products is the drum dryer. A slowly revolving steam-heated drum dips into a shallow pan or tray (or meets a uniform spray of material) and the resulting thin film is evaporated to dryness in about three-quarters of a revolution and loosened from the drum by adjustable scrapers. Elaborate precautions have to be taken to ensure that a satisfactory film is formed and the scrapers bear on the drum with proper pressure and at an optimum angle. The condensate and non-condensible gases must be removed from the interior of the drum with great promptness, as it is known that the presence of 0.5% of non-condensible gases reduces the coefficient of heat transfer by 50%. For dealing with sensitive materials like milk a vacuum drum dryer has been popular, particularly in America. Apart from the enormous expense and the trouble in discharging the solid product against the vacuum in the dryer, the product is, as a rule, unsatisfactory. Thus it is impossible to produce a reversible milk powder because of the over-heating of the film in contact with the steam heated surface. Steam at sub-atmospheric pressure is sometimes employed for heating, but the consequent low temperature gradient results in incomplete desiccation, and the keeping qualities of the powder are thereby impaired.

The most attractive proposition for sensitive organic substances is spray drying which, although comparatively recent, has displaced the vacuum drum dryer for many purposes. The range of application is unusually wide insomuch as, besides a variety of fluid and semi-fluid inorganic, organic and biological substances, solid precipitates in suspension, such as dye-stuffs, can be satisfactorily handled and a dry powder of uniform particle size produced thereby eliminating the subsequent operations of grinding and sieving. A spray of the material is brought into contact with dry, hot air and as a result of the enormous surface exposed (about 10,000 sq. ft. per gallon), drying is almost instantaneous and the product is collected in bag filters. The adiabatic cooling of the air ensures a very low temperature (about 40°C.) of the particles being dried. Although the average temperature of the drying chamber is appreciably higher, the product is subjected to this temperature only when it is dry and comparatively stable towards heat. Thus egg albumen which coagulates at 60°C. can be spray-dried to a reversible powder with hot air at 100°C. or more. In fact recent practice tends to employ gases at 400-500°C. when dealing with sensitive organic substances.

Hitherto spray drying was considered suitable only for expensive products; but in view of recent developments in industrial process equipment, it would appear practicable to adapt the process to cheaper substances like sugar, and an attempt in this direction is being made by the author. Complicated rotary spraying devices, consisting of discs of special design rotating at ten to twenty thousand revolutions per minute, can be substituted in many cases by cheap modern spray nozzles. Revolutionary designs of dual dust-collecting-and-exhausting fans are available, which would make it feasible to eliminate the customary bulky and expensive bag filters. The

drawback of a low thermal efficiency, which is the principal objection against spray drying, can be readily overcome by using products of gaseous combustion, or even exhaust gases from suction gas engines, in place of drying air. Spray drying would then simplify itself into a cheap, rapid and easily operated process suited to common industrial requirements.

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BIOLOGICAL MATERIALS.—I. *M. Sreenivasaya.*—Most of the biological materials are hydrophillic colloids and contain thermo-labile constituents, often sensitive to changes in hydrogen-ion concentration, contamination with heavy metals like lead and copper and atmospheric oxygen. Enzymes, vitamin concentrates, harmones, antitoxins and therapeutic sera, large quantities of which are now being prepared, come under this category. They are usually associated with other relatively inert bodies which have the characteristics of a true colloid.

These products require to be desiccated under conditions least harmful to the essential constituent or the active principle and the operation should be speeded up since the materials are liable to microbial infection in the wet condition. The colloidality renders the diffusion of water through the gel to the evaporating surface slow and the crust formation hinders further evaporation.

In the preparation of most enzyme preparations, treatment with absolute acetone offers a very convenient and rapid method. For example, yeast zymase or Taka-diastase fungus powder is prepared in this manner. When all the constituents are desired the solvent method is unsuitable; film or spray drying is then usually employed.

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BIOLOGICAL MATERIALS.—II. *Gilbert J. Fowler.*—The drying of *Activated Sludge* involves a number of special considerations. Well "conditioned" activated sludge consists mainly of zoogloeal masses of bacteria and other micro-organisms. In bulk it is a gelatinous mass which holds a critical percentage of water very tenaciously. Percentages above 80 per cent. or so can be readily drained off, the remainder constitutes the problem. Left to air dry at temperatures below say 70°F., the drained sludge remains more or less indefinitely as a putty-like mass, if indeed it does not decompose and become offensive.

If dried in thick layers at tropical sun temperature, it is converted into horny lumps difficult to powder.

The method adopted at Milwaukee, where large-scale drying has been undertaken is to drain off the "excess" water on Oilver Filters, and dry the residue with its 80 per cent. moisture at a high temperature in rotary driers. By such a method there is likelihood of loss of nitrogen through driving off of volatile products, and of rendering the remaining percentage less "available" for plant food than is the undried product. Moreover the whole of the 80 per cent. moisture has to be evaporated.

The Fowler Drying Mat, specially devised for the drying of activated sludge, and for which a Patent has been granted in the U.S.A., seeks to avoid these disadvantages.

By employing a surface of stiff parallel vertical fibres on which the colloidal jelly rests (an endless moving band of specially compact coir mat, in fact), the excess water is rapidly drawn away from the film of jelly. When hot air is passed over this thickened jelly as it rests on the mat, the jelly "cracks", and the "bound" water is released and runs away between the fibres of the mat, leaving a thin dry sheet of sludge on the mat, which can easily be brushed off as the mat rotates, and the fibres open at the turn of the mat.

Successful preliminary trials have been made at Cawnpore and Nagpur, and a model is now under observation at the Ishapore Rifle Factory near Calcutta.

The Cawnpore experiments showed that with a film of sludge not exceeding 1/8 inch in thickness, and hot air at a temperature approaching 200°C., the jelly could be dried in about a quarter of an hour.

An air temperature of 200°C. does not mean that the mat reaches that temperature. It is constantly moist with the water percolating from the "cracking" jelly, and the brown paper like film of sludge prevents rapid conduction of heat. It has been found advisable to oil the fibres of the mat in order to prevent adherence of the sludge and penetration of soluble salts into the fibres.

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DRYING OF FOODS AND CONDIMENTS.—*B. N. Banerjee.*—The water content of any food material determines its perishability or keeping quality: cereals, grams and pulses and nuts are non-perishable; less juicy fruits and vegetables like potatoes, carrots, apples and pears are semi-perishable; and juicy fruits and vegetables and other products like milk or eggs are perishable. The practice of dehydration is to prevent perishability and help in the storage of foods and condiments. Dewatering is carried to an extent and in a way, so that the taste, flavour and nutritional value are not lost or impaired and keeping quality ensured. The dried product weighs only a fraction of the original weight and a great saving is assured in packing, labour and transport. The entire product is easily rendered edible on re-hydration.

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SUGAR INDUSTRY.—*G. Gundu Rao*.—Drying in sugar industry which forms generally the very last stage is usually accompanied in the centrifugals where large volumes of air incidentally drawn effect a partial desiccation of the sugar crystals. This process is aided by raising the temperature of the baskets by means of steam.

To secure a more complete drying, the product is carried to an upper floor of the factory and fed into the hopper of a long inclined drum rotating on its longitudinal axis, once in about six minutes. In the interior of the drum and attached to its wall are vanes whose free edges are cut into teeth like those of a saw. A counter-current of hot air (180°F.) blown from the opposite end effects the drying of sugar in about 20 minutes. There are several modifications of such driers. Recently, the Jenkin's vertical type of drier is coming into favour. The chief feature of this type is a central rotating shaft carrying trays along its length. Sugar is fed into the topmost tray and is then thrown down from tray to tray as the shaft rotates. The sugar crystals have a chance of being exposed to the upward stream of hot air for the maximum length of time and the possibility of incrustation is thereby reduced.

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DRYING IN PAINTS AND PIGMENTS. *S. K. Datar.*—Pigments required for paint manufacture are either obtained from natural sources or prepared by precipitation. Natural pigments require powdering or levigating or both before they can be utilised. There are machines to powder coarse pigments dry in one operation to 300-400 mesh; in other cases the pigments are levigated in water. Both levigated and the artificially precipitated pigments which have a varying water content of 20-50 per cent. require to be thoroughly dried before they can be incorporated in the paints.

Their water content can be reduced to a certain extent by filter pressing at high pressures, but for preparing them in a dry condition they require further treatment. A simple way of drying is to leave the pigment in trays in thin layers on racks for days, exposed to air, but this or even the sun drying are slow processes and are subjected to contamination by gritty particles and dust. A quicker way is to dry in suitably constructed chambers heated by fire, steam or electricity. In the case of white lead simple open air drying is extremely slow and involves the risk of contamination by dust and discolouration. Drying in a chamber heated by flue gases has been found to be uneconomical.

By replacing water in filter-pressed white lead with linseed oil, the process of drying can be completely eliminated. The old way of preparing the paint was to mix previously dried and powdered white lead with oil in a pugmill. The modified process, in which the white lead from the filter press containing about 25 per cent. water, is directly pugged with linseed oil, has proved successful as the white lead has an affinity for oil in preference to water which readily separates.

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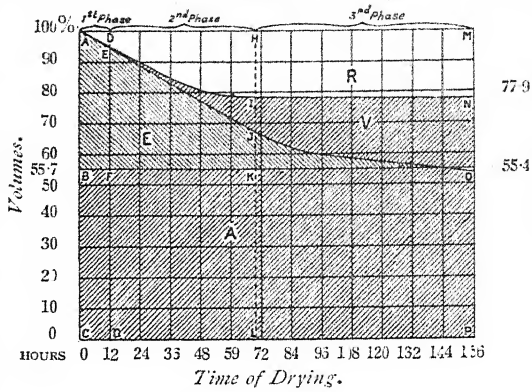
CERAMICS.—*N. V. Raghunath.*—Wet process, Dry process and Casting process are three methods of manufacture of porcelain.

The prepared body material employed in the wet process contains 25 per cent. of moisture. As soon as the articles are shaped in Plaster-of-Paris moulds constituting the moulding material to absorb water thus leading to a shrinkage in volume of the article. The greatest care has to be taken to see that the articles do not crack while in the moulds. A high humidity of the surrounding atmosphere ensures favourable conditions for drying and prevents "case hardening".

In the first stage (see figure) the shrinkage is proportional to the amount of moisture driven out. In the second, shrinkage and pores occur as well as the driving out of a certain amount of moisture. In the third stage, there is no shrinkage but only loss of water and the formation of more pores.

The chemically combined water is driven out at a higher temperature and at 500°C. it is completely driven out. The chemically combined water is driven out in kilns which are fired by coal, gas, electricity or wood.



Drying Chart.

R.=Shrinkage. E.=Water. V.=Pores. A.=Clay.

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DRYING OF TIMBER.—*C. Varadhan.*—The chief objects of drying timber are to reduce its weight, to increase its strength, to prevent decay and to minimise changes in its dimensions, after it is made up into furniture, etc. The moisture in wood is of two kinds, free moisture contained in the cells and hygroscopic moisture absorbed by the cell walls. The problem in all processes of drying timber is to remove all the free water, without producing case-hardening, unequal shrinkages and other defects which ultimately result in cracking and splitting of the wood. Modern methods of kiln-drying in which the wood is stacked in kilns, consist of drying by properly conditioned air. The heating is done by steam pipes, the humidity controlled by steam or water sprays and the circulation effected by convection currents or forced draught. The actual temperature, humidity and other working conditions depend on the particular species of wood. Among other methods of seasoning are the old haphazard one of seasoning in the open air, soaking in water followed by air-drying and the electrical methods.

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Messrs. B. Sanjiva Rao and K. L. Ramaswami in presenting laboratory aspects of drying, dealt with the relative efficiency of several desiccating agents. Mr. Krishna drew attention to the importance of drying in the pharmaceutical industries where preservation of the potency of drugs like digitalis is greatly influenced by variations in moisture content.

A detailed discussion followed under various aspects of the problem.

Preparation of Fine Chemicals.*

By B. H. Iyer, M.Sc., A.I.I.Sc.

WITH the development of chemical industry in an organised form from the middle of the 19th century, the entire chemicals have been classified into two main divisions, *viz.*, Heavy Chemicals and Fine Chemicals. Mineral acids like sulphuric, hydrochloric, nitric and phosphoric, caustic alkalies of soda and potash, their carbonates and bicarbonates and many of the inorganic salts manufactured on a tonnage basis belong to the class of Heavy Chemicals. Analytical, pharmaceutical, photographic and rare earth chemicals, synthetic essences and perfumes, synthetic dyestuffs and research chemicals are considered as Fine Chemicals. As the organic compounds constitute a major portion of this class of substances, the progress of fine chemical industry has been intimately connected with the successful utilisation of the petroleum and coal-tar products—the two chief sources of organic compounds. For nearly half a century ending with the commencement of the Great World War in 1914, Germany was holding the sole monopoly for all fine chemicals. The War having shown the need for self-sufficiency, Great Britain and America mustered up their energies and creditably built up their respective national fine chemical industries. The humble but successful efforts to prepare the necessary research chemicals made by Prof. C. G. Derick of the University of Illinois in 1916 and ably continued by Prof. Roger Adams and others, brought into existence, the valuable 'Department of Synthetic Chemistry' of the Eastman Kodak Company, Rochester. While nations all around have been developing this very necessary branch of chemical industry, India has been depending on foreign countries for her needs.

The various processes employed in the preparation of these substances, may be divided into three groups:
(1) Inorganic Chemicals, (2) Organic Chemicals, and (3) Chemicals prepared by the action of biological agents. Inorganic chemicals are smaller in number than the organic compounds. Inorganic reactions are comparatively simple and the yields therefrom are better than in organic reactions. In the organic field, the process is hindered by the formation of more products than one, due to side reactions. The factors which decide the production of a desired product in good yield are temperature, pressure, concentration and the agent used for bringing about the reaction. Catalytic oxidation and reduction play an important part in synthetic chemistry. Employment of high temperature and pressure has enabled chemists to conveniently prepare very many of the compounds which could be obtained only in small quantities with great difficulty, before. Soda-water bottles lodged in iron frames and provided with rubber washers pressed in position by a screw arrangement, offer a convenient method of carrying out reaction under pressure. The insertion of a capillary tube in the cork used for sealing facilitates release of pressure, if present, at the end of the reaction. The process of fermentation by fungi, moulds or bacteria is revolutionising some of the synthetic methods. Although intensive research has enabled chemists to synthesise many of the natural products, their methods are entirely different from those adapted by Nature which does not involve the employment of such high or low temperatures or pressures or such strong acidic or alkaline media which are proved necessary for the manufacturing processes. Biochemistry would do a real service when it explores the subtle secrets of Nature and enables scientists to copy *in toto* the natural methods in the synthetic experiments.

The spread of civilization and the progress of research in this country demand an early establishment of a fine chemical industry in India. Although there are no separate statistical import figures, the knowledge that on an average 474 lakhs of rupees worth of chemicals, drugs and medicines and another 390 lakhs of rupees worth of dyes and colours are imported annually into British India, ought to be sufficient to set the industrial mind thinking as to what should be done.

In August 1930 a Preparation Section attached to the Department of Organic Chemistry, Indian Institute of Science, Bangalore, was started, for the first time in India, due to the efforts of Dr. P. C. Guha. This Section prepares almost all organic research chemicals necessary for work in the laboratories. Within these three years, more than a hundred different chemicals have been prepared in considerable quantities. This enterprise has proved useful in making special chemicals of requisite purity immediately available for research at low cost. Most of the chemicals costing more than Rs. 15 per kilogramme have, in fact, been prepared with a large margin of profit. The Section has proved useful in imparting valuable training in preparative chemistry to post-graduate research students.

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*Abstracted from a lecture given under the auspices of the South Indian Science Association, Bangalore, on 24th November 1933.

Science News.

All-India Medical Licentiates' Conference.—The twenty-sixth session of the conference will be held at Bombay during the last week of December. The Bombay Branch of the All-India Medical Licentiate Association has organised a sanitary and scientific exhibition for the occasion.

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Under the auspices of the Association of Economic Biologists, Coimbatore, a meeting was held on the 24th November, when two papers (1) The Problem of Selection in Hybrid Progenies—by V. R. Ayyar, (2) Some aspects of the drought resistance with special reference to cotton—by R. Sankaran, were read and discussed. In the course of his address on the Problem of Selection, Mr. V. R. Ayyar pointed out that the adoption of either the Mendelian or the Svalof method has neither completely eliminated the element of uncertainty in alighting on promising lines, nor reduced to its minimum, the time factor involved in the production of useful strains. Much improvement does not seem to be feasible in the Svalof method ; while the usefulness of the Mendelian method can be enhanced by carrying out the rejection of poor yielders except in cases of structurally sterile plants, by their comparative performances in the F. 3 generation raised in rows of suitable length and alternated with the standards.

In dealing with drought resistance of plants, Mr. Sankaran drew attention to the need for a close study of the morphological, anatomical and physiological organisation of the plant body for understanding the problem. The results obtained from a study of these factors in two varieties of cotton—Gossipium *herbaceum* and Gossipium *indicum*, were discussed.

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Agricultural Research.—At its meeting held in Delhi during the last week of November the Governing Body of the Imperial Council of Agricultural Research discussed several important agricultural research schemes. Among the schemes sanctioned, are (1) research on rural pisciculture from Madras ; (2) research on economics of irrigation from tube wells from the Bihar and Orissa Government ; (3) research on animal nutrition to be carried on at the Imperial Institute of Animal Husbandry and Dairying at Bangalore, the Agricultural College at Lyallpur and at the Indian Institute of Science, Bangalore ; (4) research in vegetable oil technology to be carried out at the Harcourt Butler Technological Institute, Cawnpore. The Governing Body also decided to set up an Indian Sugar Trade Information Service and to establish a number of fellowships for scientific research in Agriculture and Animal Husbandry, and to invite donations and subscriptions from the general public for this purpose.

* * *

Patna Science College Philosophical Society.—The annual report for the session 1932-33, which has been recently published shows that during the past three years of its existence the Society has done considerable useful work, firstly by holding periodical meetings of the members for discussion of scientific subjects and secondly, by arranging popular lectures for the benefit of the public. The Society publishes an annual bulletin and the present number extends over 63 pages and comprises 7 original papers.

* * *

Indian Institute for Medical Research.—A scheme for the establishment of an Indian Institute for Medical Research for investigating problems of medical science and "to train a band of research workers to apply the knowledge obtained to clinical practice and to preventive medicine and to disseminate the knowledge of hygiene among the masses, making its services available to them either free or at a low cost." The Institute will comprise of six departments, Bacteriology and Pathology, Tuberculosis, Biochemistry and Nutrition, Protozoology, Experimental Pharmacology and indigenous drugs enquiry and Diagnostic Laboratory and Clinical Work. The initial expenses for starting such an Institute will be Rs. 1,25,000 and the recurring expenditure will be 1,10,000 annually. The sponsors of the scheme consisting of eminent men of the country have appealed to the generosity of the public for the initial expenditure necessary to establish the Institute and to enable it to function for the first year, namely, the sum of Rs. 1,25,000. It is hoped that the Institute will be self-supporting after the first year.

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The 21st Session of the Indian Science Congress will be held at *Bombay* and not at Poona as previously announced, between the 2nd and 8th January 1934. Prof. Meghnad Saha, D.SC., F.R.S., will preside over the deliberations.

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The Ninth Session of the Philosophical Congress which was previously announced to be held at Poona during the last week of December, has been postponed to Easter, 1934. The exact dates will be announced later.

* * *

Technological Education in Bombay.—A new University Department of Chemical Technology was recently inaugurated by His Excellency Sir Frederick Sykes and theDepartment is temporarily housed in the Royal Institute of Science. The need for adequate technological education in the Presidency was being felt for some time past and as a result of the deliberations of expert committees who investigated the question in all its aspects, a practical Scheme has now been evolved which ensures instruction on thoroughly practical lines, turning out experts with training and experience who can be of real assistance to the various industries of the country. The new department is completely self-contained and serves not only to impart instruction and training, but also provides facilities for research in Chemistry and Chemical Engineering. The University has already received donations to the extent of 2 lakhs of Rupees from the discerning public and industrialists of Bombay, and it is hoped that more financial help would be forthcoming which would make the extension of the present Department possible.

* * *

Agricultural Institute for Rajshahi.—A scheme for starting an Institute for imparting training in Agriculture, has been formulated, following a

Conference between representatives of the Government and the executors of the endowment made by the late Kumar Basanta Kumar Roy of Dighapatia. The training will include both practical and theoretical aspects of Agriculture, and will be a two-year course. The recurring costs will be met from the interest which amounts to about Rs. 16,000 per year.

* * *

Nobel Prize in Medicine for 1933.—It is understood that Prof. Thomas Hunt Morgan, For. Mem. R.S., of the California Institute of Technology, has been awarded the Nobel Prize for 1933 in recognition of the importance of his investigation on Heredity for the advancement of medicine.

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Journal of the Annamalai University.—We acknowledge with thanks the receipt of the *Journal of the Annamalai University* (Vol. II, No. 2) published by the University. The Journal includes original contributions not only on subjects connected with experimental sciences but also with humanistic sciences and Tamil and Sanskrit literature. It would appear preferable to separate the various subjects, and publish them as separate parts. We congratulate the Board of Editors on the excellent get-up of the Journal.

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The next session of the All-India Economic Conference will be held at Annamalainagar under the auspices of the Annamalai University on the 2nd January 1934. His Excellency the Governor of Madras has graciously consented to open the session.

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Universities Conference.—The quinquennial Universities Conference will be held at Delhi on the 6th, 7th and 8th March 1934, under the auspices of the Inter-University Board. One of the important subjects that will come up for discussion before the Board concerns Technological Education in India. Sir C. V. Raman, F.R.S., N.L., Director, Indian Institute of Science, Bangalore, has been deputed by the Institute Council to attend the Conference.

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Sugar Research in India.—Following a meeting of the Sugar Committee at Coimbatore on the 15th of November, proposals were formulated for the establishment of a Sugar Research Institute under the control of the Imperial Council of Agricultural Research. The proposed Institute will be provided with facilities for carrying out research on sugar in all its aspects and the Coimbatore Sugar Station will be made a part of this central Institute, which will also be linked up with Harcourt Butler Institute in Cawnpore. More details about the Coimbatore Conference appear elsewhere in this issue.

* * *

New Carl Zeiss Apparatuses for Microscopists.—We have received from the local Sole Agents of Messrs. Carl Zeiss, literatures concerning three new and important introductions by them in Microscopy which appear to us to be of interest to our readers. Firstly, a new design in microscope has been evolved in the series L, H & V. The chief features in all these consist in securing a sensitivity in the slow motion, hitherto unachieved, *viz.*, of 1/1000th of a mm. per each interval of the drum-head. Another factor that makes for great facility in working the hands is that both the rough and slow motion drum-heads have been placed near the bottom of the stand, while other features vary in the three individual types. Next a new series of Epicondensers with illuminating systems have been brought forward which enable microscopic observations of surfaces and layers underneath without any need for microtome sectioning or staining. Under this system of illumination the microscopic structures are seen in their natural setting and colour somewhat as under a semi-dark-field illumination. Thirdly, the Mikro-Polychromar attachment has been designed to produce two systems of coloured beams of rays so that any preparation or object is illuminated by two systems of coloured beams, one along the path of the optical line of sight and the other which crosses it nearly at right angles. The different structures of the object produce a magnificent contrast, for example the cell wall and objects of colloidal dimensions scatter one kind of colour while the protoplasm or cell contents transmit another colour. We are sure the new series of microscopes and the two new types of illuminating mechanisms will be welcome to all microscopists.

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We acknowledge with thanks the receipt of the following:—

"Nature," Vol. 132, Nos. 3337 to 3340.

"The Chemical Age," Vol. 29, Nos. 746 to 749.

"Canadian Journal of Research," Vol. 9, No. 3.

"The Journal of Chemical Physics," Vol. I, No. 10.

"The Biochemical Journal," Vol. 27, No. 4.

"Berichte der Deutschen Chemischen Gessellschaft," 66 Jahrg, No. 10.

"Natural History," Vol. 33, No. 6.

"Journal of Agricultural Research," Vol. 47, No. 5.

"American Journal of Botany," Vol. 20, No. 8.

"Journal de Chemie Physique," Tome 30, No. 8.

"The Journal of Nutrition," Vol. 6, No. 5.

"The Review of Scientific Instruments," Vol. 4, No. 10.

"Medico-Surgical Suggestions," Vol. 2, No. 10.

"Journal of the Russian Chemical Society," LXV, Tome III, Livres 4 & 5.

"The Indian Journal of Medical Research," Vol. 21, No. 2.

"Indian Forest Records," Vol. 19, part 3; Vol. 15, part 8; Vol. 18, part 11.

"Dominion of Canada, Department of Agriculture" Pamphlet, Nos. 146, 147, 150, 157, 159, 160, 161, 165.

Report of the Minister of Agriculture for the Dominion of Canada, ending March 1932.

Reviews.

PHYSICAL MECHANICS: An Intermediate Text for Students of the Physical Sciences. By Robert Bruce Lindsay, Ph.D., Associate Professor of Theoretical Physics in Brown University. Pp. x+436. (London: Chapman and Hall, Ltd., 1933. Price 21*s.* net.)

This is a book quite out of the ordinary. The author has made a very definite and successful attempt to break away from the traditional method of presenting mechanics and the result is a thoroughly modern book which will very well fit the student, who uses it as a Text-book, to enter, later on, into the enchanting domain of modern Theoretical Physics.

The book is described as an intermediate text for students of the physical sciences, but, the fact is that the book can be recommended as an exceptionally well-written introduction to mechanics suitable for students of mathematics as well as of the physical sciences. The author maintains throughout a satisfactory balance between the physical and mathematical aspects of the subject, between general principles on the one side and applications to physics on the other. It can safely be recommended as an ideal book for study by mathematics and physics Honours students of the Indian Universities in the penultimate year of the Honours course.

No work on mechanics can be regarded as fully adequate that shuns the use of vectors where they undoubtedly contribute to clarity and simplicity. In the present case they are used judiciously appearing here and there throughout the work. Some important features of the work which distinguish it from the ordinary text-books on mechanics will now be noticed.

The treatment in Chapter I of mass and force and the laws of motion is quite rigorous and the early introduction of the mechanical principle of relativity is very satisfactory. The electron motions in the Bohr model of the H-atom and the α-particle deflection as examples of motion in central fields of force are extremely well done. Chapter IV contains an elementary theory of the gravitational potential and Gauss' law of normal force, Laplace's and Poisson's equations are all derived in a simple and direct manner. The motion of a rigid body about a point is particularly well handled in Chapter VII by the use of the vector notation. One would, however, have liked to see the bracket notation for vector and scalar products replace the product notation used in the book. An innovation introduced in Chapter VIII is Gauss' principle of least constraint and the author has been very successful in the logical presentation of the topic. The chapter bearing the heading "Oscillations" includes a study of the simple harmonic oscillator in atomic theory. Chapter X is by far the finest in the book, and deals with the motion of a system of particles. A beautiful introduction is given to the elements of the kinetic theory of gases. The notion of generalised co-ordinates, Lagrange's equations and Hamilton's principle are all introduced in their appropriate places. Excellent as this chapter is, it could have been made more complete by introducing, in the body of the book, the canonical equations of motion and the Hamilton-Jacobi differential equation. Chapter XI is devoted in part to wave motion under which category several diverse types are studied. This chapter also contains the outlines of the elements of the theory of elasticity and is that portion of the book, which, according to the author, has an "engineering slant". But what little is given of this topic is, however, very well done. At the end of the chapter is given a survey of the wave mechanics of DeBroglie and Schrödinger. While it is possible that there can be two opinions regarding the wisdom or utility of introducing this subject in a book of this nature, there can be no question as to the extremely clear and simple presentation of the topic by the author. In Chapter XII a welcome addition to the usual topics dealt with under hydrostatics and hydrodynamics and a feature illustrating the modern nature of the book are the articles treating of viscous fluids, surface phenomena like capillarity and adsorption.

The book is remarkably free from misprints and there are no serious errors. The reviewer would recommend the deletion of Ex. 1, p. 47, and Ex. 1, p. 313, as being rather crude. Another notable feature is the decimal classification of the articles which enables the author to arrange the formulæ with ease. The book is very well produced as, it must be admitted, its price demands.

B. S. M.

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HIGH FREQUENCY MEASUREMENTS. By August Hund. First Edition. Pages xi+491. (Published by McGraw Hill Book Company, Inc. New York and London. 1933.)

To those who are acquainted with Dr. Hund's "Hochfrequenmesstechnick" this present work will be a welcome addition as an important and useful contribution to the literature on the ever-widening field of high frequency measurements. In the range of the subjects dealt with and in the treatment given to each, this ably-written book is a very comprehensive and up-to-date treatise.

The most valuable feature of the book is that the subject is dealt with in no narrow or mechanical manner; at every stage the discussion takes into its sweep inter-relations with allied subjects and thus helps at obtaining a correct and comprehensive perspective.

In the measurement of the different quantities, such as frequency, current, resistance, inductance, etc., the choice of method in relation to the magnitude is given careful examination. Wherever practicable, the constants in a formula are evaluated for ready use. In some cases worked examples are given for purposes of illustration in addition to indication in small type of experimental procedure.

Considerable space has rightly been devoted to the cathode ray oscillograph, its construction, performance and use for a variety of high frequency measurements. Its applications are increasing so rapidly, that it has very nearly become an indispensable instrument. The inclusion of a brief chapter on wave propagation measurements is proof of the increasing interest in the subject. Special measurements such as those of reflection coefficients, critical frequencies, etc., are not yet in such a stage of development as to be considered in a book of this type at present.

The simplest type of high frequency measurement involves some familiarity with the theory of the electro-magnetic field and the electron theory of matter on the one hand and fairly detailed knowledge of continuous and alternating current technology on the other. A brief discussion of the two would therefore have been a suitable beginning for the book. Circuit analysis properly takes the next place.

The question of standards does not appear to obtain the emphasis that is due to it. There is no mention, for example, of the tuning fork as a standard of reference, although it is so used in a number of countries. Measurement on triode oscillators find no place in the book.

The use of small print may be justified to some extent as a means of indicating matter, which, though not strictly part of the main text, is helpful to the understanding of the subject. But the diagrams and curves and particularly the explanatory letters and words in them are so small in size as to tax the eyes of any normal reader. There can be no doubt that with bigger diagrams and the avoidance of small print, the book would undergo a substantial increase in its size. But that is of secondary importance.

Apart from a few errors in the names of scientists such as "K. Omnes" on page 262 in place of "H. K. Onnes" and "G. Gonbau" on page 411 instead of "G. Goubau", the text appears to be free from errors.

Altogether a very fine and useful work.

R. E.

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WIRELESS RECEIVERS. By C. W. Oatley. Pp. 103. (Published by Methuen & Co., Ltd., London. 2*s*. 6*d*. net.)

With the remarkable spread of radio broadcasting and of the growth of short and long distance commercial radio telegraph and telephone systems the world over, the problem of reception methods and apparatus have increased enormously in volume and complexity. No book of the size under review can possibly attempt any worth-while treatment of the subject.

Mr. Oatley presents in this little volume of 100 pages a brief but clear treatment of the essential principles underlying the working of the different parts of a radio receiver, with special reference to distortionless broadcast reception.

Starting with the basic ideas of a modulated wave and of the different types of distortion in a receiver, the author deals with the essential characteristics of a triode. It is probably more usual to use slope conductance $\frac{\partial i_a}{\partial e_a}$ than its inverse, as the former accords with the mutual conductance $\frac{\partial i_a}{\partial e_g}$. It is noticed that K instead of G is used for $\frac{\partial i_a}{\partial e_g}$. Figures 2 (*b*) on page 9 and 39 (*b*) on page 89 require modification as they show the anode currents to be zero for appreciable values of the anode voltage.

In dealing with the antenna-earth system, a few typical circuits used for transferring the antenna voltages to the amplifier grid are analysed. Then follows a discussion of the different circuit arrangements used for high frequency amplification and of the methods adopted to overcome the effect of the anode-grid capacity on stability of working.

The two main types of detection are examined in Chapter V along with their relative performances for normal reception conditions. The treatment of low frequency amplifiers follows the usual lines and includes a description of the advantages of the push-pull arrangement.

In some respects, the chapter on the power stage is perhaps the most useful, as the discussion deals with the triode as an integral part of the whole circuit.

The book is a clear exposition of the essential ground work and is meant to meet the needs of the student of general physics and of the serious amateur.

Limitations of space are obviously responsible for the omission of any treatment of diode detection, heterodyne and superheterodyne reception, high frequency bandpass and low pass filters for sectivity and tone correction, power supply to receivers, and other relevant questions.

The printing and diagrams leave nothing to be added and the text is apparently free from errors. A handy volume well worth its price like the other excellent companion volumes of the series.

R. E.

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ELEMENTARY INDUSTRIAL ELECTRICITY. By L. Raymond Smith. Second edition (1933). Industrial Physics Series.

This little book aims at introducing the students of electrical and allied trades to the elementary principles of electrical circuits, measurements and simple machinery, and fulfils this purpose very satisfactorily. It should also be useful to many others who have to handle simple electrical circuits and machinery in the course of their work. No previous knowledge of electricity is assumed and an attempt has been made to explain everything in non-technical language from first principles so that it should not be difficult for anybody familiar with elementary physics to go through the book without the help of a teacher. The practical aspect of the subject is kept well in mind and most of the principles have been illustrated by a number of very good practical examples. It contains simple but very clear diagrams and an attempt has been made to deal with every subject on a quantitative basis as far as possible. The additional chapter on alternating currents explains the first principles in a lucid manner. Few books of its kind are available and the revised edition should therefore be very welcome to those for whom it is intended.

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AN ELEMENTARY TEXT-BOOK OF SOUND FOR B.SC. PASS STUDENTS. By R. N. Ghose, D.Sc., A.Inst.P.

The number of books on scientific topics written by Indians is now on the increase. The present volume is conceived on an ambitious scale and is fairly exhaustive. The explanation of physical phenomena is generally detailed and in some cases too much so. The problems dealt with in their mathematical aspects are well chosen. The inclusion of a large number of topics of present-day interest such as the talkie film, the loud speaker, the piezo-electric oscillator, the gramophone, the hydrophone, sound ranging, etc., besides the chapter on the acoustics of buildings enhances the value of the book.

The get-up of the book is very good, and the publishers, Nand Kishore & Bros. of Benares, are to be congratulated for their excellent work.

The arrangement of the subject-matter leaves room for improvement.

There are, however, a few inaccuracies and in several places marked lapses in language, *e.g.*, on p. 3, line 10 and p. 6, line 22, the definitions of wave length are incorrect; on p. 18, line 6, the statement "Then $-\pi$" is obviously wrong; on p. 19, line 20, "$\frac{1}{r}$, where r is an integer" should be "m/n, where m and n are integers"; on p. 30, lines 26-27, "fig. 18" is a misprint for "fig. 17" and the reference "*octave*" is no doubt the *second harmonic*. Similarly, on p. 37, line 8, "$y \propto e^i$, and $\frac{d^2y}{dx^2} = -\frac{2}{v^2}y$" and on p. 47, lines 32-34, the jumble of words "two elements....extension e is" are probably evidences of careless proof-reading. There are many more such inaccuracies and lapses which mar the usefulness of the book.

On the other hand, the following errors of expression among a fairly large number, could have been avoided with a little care,

e.g., p. 7, line 6, "listen the sound"; p. 7, lines 8-9, "the angle .... remains" for "angles .... are"; p. 9, line 5, "is greatly interfered by the direction"; p. 18, line 14, "composing" for "composition" and line 31, "minima" for "minimum"; p. 23, lines 33-35, "one particle" .... "both the ends" .... "pegs at 1 cm. apart"; p. 29, line 29, "density of air per c.c."; etc., etc.

The frequent omission of the articles "a" or "the" and their occasional insertion in wrong places strikes even a casual reader.

It is to be hoped that these several defects will be eliminated in a second edition of the book.

A. V. T.

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HYDROGEN-ION CONCENTRATION AND ITS PRACTICAL APPLICATIONS. By Frank L. La Motte, William R. Kenny and Allen B. Reed. Pp. 262. (Bailliere Tindall and Cox, London. 1932. Price 20*s*.)

This book which is the outcome of the labours of three technical chemists whose names are not unfamiliar to those interested in the subject of Hydrogen-ion concentration, forms a useful addition to the large number of books now extant. Its special appeal is to the operating chemist who has discovered in Hydrogen-ion control a new and useful instrument, finding intensive application in diverse technological processes. The book thus deals exclusively with the application of hydrogen-ion in industry, a preliminary discourse covering about 55 pages being included with a view to give a somewhat elementary treatment of the theoretical aspects of the subject which will be found useful to those whose early scientific training has not included this phase of chemistry.

The simple principles involved in pH measurement find adequate explanation in non-technical language which can be understood even by a lay chemist. The potentiometric method is excluded from the treatment. The inclusion of the glass electrode whose discovery has made possible an accurate determination of the Hydrogen-ion concentration of unbuffered solutions, and oxidising and reducing media, and the quinhydrone electrode method (or its several modifications such as the hydro-quinhydrone method) which yields good results in the hands of even beginners, would have greatly added to the value of the book.

One of the special features of this publication is the inclusion of charts, which indicate at a glance the important pH zones requiring attention in the various industries which have been surveyed in the volume, and these would prove of great assistance to the practical chemist. Selected references are added at the end of each chapter. Most of them refer to publications of 1927 or earlier years. One would have wished for a more up-to-date and comprehensive list of references. Some space could have been usefully devoted to the rubber industry, in which standardisation of conditions for manufacture of various goods for latex calls for pH control.

On the whole, the book is a useful addition to the library of every chemist to whom it will prove to be, as the authors have claimed, "a useful guide capable of assisting routine problems".

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MASS-SPECTRA AND ISOTOPES. By Dr. F. W. Aston, SC.D., F.R.S., Nobel Laureate. Pp. xii + 248 (Edwin Arnold & Co., London. 1933. Price 15*s*. net.)

This new book by Dr. Aston is a natural sequel to his well-known book "Isotopes", a second edition of which appeared nine years ago. This extraordinarily valuable book is divided in a very happy manner into four parts which deal with the subject-matter from the following aspects: (1) Historical; (2) Production and analysis of mass-spectra; (3) The elements and their isotopes; and (4) Theoretical and general.

The subject-matter of Part I (54 pp.) is substantially the same as that presented in "Isotopes", the obvious reason for this being that even to-day it serves as an eminently suitable historical introduction to the subject of mass-spectra. Part II deals with the experimental methods employed for the production and measurement of mass-spectra. It is well-nigh impossible to speak too highly of the merits of this portion of the book presenting as it does with characteristic detail an account of experimental work of the most refined type. The unforeseen difficulties which had to be overcome before the second mass-spectrograph could be put into successful operation are described in an impressive manner; thus, in p. 77 for instance, "After months of disappointing work it was found that the cause was a polarization of the surfaces of the plates which might take as long as 0·05 second to reach its maximum value. Drastic scrubbing with emery paper reduced the effect temporarily and also the curvature of

the lines which is due to the same cause, and the plates were later heavily gilded. With a clean gilded surface the effect was reduced to manageable proportions. Arrangements were now made to measure it with the highest accuracy possible."

In Part III Dr. Aston presents in outline the evidence on which the isotopic constitution of each individual element was established and their bearing on important questions in clear "Chemistry". The last part of the book, *viz.*, Part IV, is mainly of theoretical and general interest. Statistics concerning the relative abundance of isotopes of the odd and the even (at no.) elements and the relative abundance of the different atomic species in the earth are shown in very elegant charts on pages 179–81 and 184–85. Two chapters are devoted to an exposition of the isotope effect in molecular and atomic spectra and a résumé of important work relating to those problems. The principles underlying the separation of isotopes are indicated in the last chapter along with a short account of the researches in which such separation was actually achieved, including that of the hydrogen isotope (H^2) obtained by Lewis only a few months ago.

Appendix I, II, and III respectively contain data relating to (1) packing fractions and isotopic weights, (2) isotopes and their percentage abundance, and (3) the periodic table of elements. The first two are thoroughly up-to-date, but it is a pity that the third, *viz.*, the periodic table, shows gaps for elements of atomic numbers 43, and 61, namely, masurium and illinium.

The book under review is one of the most readable scientific books in the English language and it can be heartily recommended for study not only to all physicists and chemists but to workers in other branches of science as well. K. R. K.

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THE NIDIFICATION OF BIRDS OF THE INDIAN EMPIRE. By E. C. STUART BAKER, C.I.E., O.B.E., F.Z.S., etc., Volume II. *Turdidæ* and *Sturnidæ*. With six plates. Pp. vi+536. (Taylor and Francis, Red Lion Court, Fleet Street, London, 31st May 1933. Price 30*s*.)

We have pleasure in according a hearty welcome to this classic memoir. The author is a leading authority on Indian ornithology and his series of contributions published in the *Journal of Bombay Natural History Society* and his volumes in the "Fauna of India" series are well known. The present volume dealing with twelve families of the order Passeres is a remarkably interesting contribution, supplementing our knowledge of the general and breeding habits of these groups hitherto derived from Oates' publication of Hume's "Nests and Eggs of Indian Birds". The great merit of the work is that in several particulars where our information was either inaccurate or defective, our knowledge of the nidification of Indian birds has been brought up-to-date by supplementing, confirming or correcting the recorded observations of the older authors. The two volumes of Mr. Stuart Baker will be an invaluable addition not only to the reference libraries of colleges where Zoology is taught, but to all public libraries where the general readers might wish to obtain information on the occurrence, distribution and habits of birds, both resident and migratory ones, which force themselves on his observation.

Nature study, however fundamental, is a neglected field in the education of the Indian child and no country is better fitted for encouraging school boys and girls to cultivate habits of observation, collection and classification of animals and plants in their immediate vicinity and it is not an uncommon thing to come across men of wide culture who know all about the universe except the little animals and plants under their very eyes. The Indian mind is generally introspective and has been rendered absolutely metaphysical by the education which lacks objectivity and realism and is totally unconnected with human surroundings. We can hardly think of any single group, of animals better calculated to attract, interest and profit the human mind than birds whose form, flight, colour, songs and voices, courtship, nets, brooding habits, eggs, nestlings and parental care, jealousies, co-operation, enemies, educability and native instincts, adaptive modifications, migration, food, rôle in the economy of nature, æsthetic sense and standard of taste and economic importance will each provide a basis for life-long study and the only equipment for it being an enquiring mind and pair of observant eyes.

The book is packed with delightful information and most of the birds dealt with are common residents of plains and hills. The main difficulty of the Indian is that he does not know how to recognise the common birds, except perhaps the crow, the sparrow

and kites and as regards the first, the grey-necked crow and the black-necked one are confused to be the female and male of the same species. Bird study should be encouraged in all rural schools and early recognition by the school children of the important part these feathered animals play in keeping the insect pests and other vermin under control and their own destructive tendencies will be invaluable in planning future campaign for their protection of the useful and elimination of the harmful ones. But the main interest must centre in the study of their habits and Stuart Baker's book provides it. We cannot emphasize the usefulness of the two volumes on the nidification of birds of the Indian Empire more than by saying that they should be found in the libraries of all educational and public institutions, clubs, and learned societies. Perhaps the inclusion of pictures of all the birds will greatly enhance the value of these volumes and if the cost is not prohibitive, we would recommend their inclusion in the future editions.

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PSYCHOLOGICAL FOUNDATIONS: A Contribution to Everyman's Knowledge of Himself. By Theodore J. Faithfull. Pp. xv+242. (John Bale, Sons, and Danielsson, Ltd., London, 1933. Price 10*s*. 6*d*. net.)

Theodore Faithfull belongs to the Freudian School and is a keen exponent of the theory of the unconscious mind and the technique of psychoanalysis. The book attempts to trace the stages of human development and the channels of perception and expression and the author hopes that it will help the study and appreciation of that Universal consciousness of life which alone can save "the human race from experiencing disaster in the coming age of plenty". Not only in education, but in criminology, psychiatry and social science, the solution of human problems depends upon a wide appreciation of and intimate acquaintance with psychology and the followers of Freud claim that this is essentially a study of duality in personal unity with all its anchorings, over-stimulations, transferences, inversions and reversions.

The evolution of mind and consciousness of sexuality as manifested in man on the intellectual and intuitional levels is traced from the simplest unicellular organisms and the chapters on the sensational and emotional and intuitional function are a contribution to Freudian exegesis. The psychoanalyst is an extraordinarily skilful interpreter of seemingly harmless things in waking and dream states in terms of sex and repressed wish. Organs like the eye, ear and nose; objects like the toothbrush, soap-box and doll; things like a tree in the landscape, marshy ground and soft wood; experiences like floating, ascending a staircase or running; and everything else has a profound sex significance in Freudian psychology. Mental affections like fear, pain, pleasure; physical states like cramping and pressure are conceived as Libido discharge. Classic myths which amused and enlightened human minds which derived invaluable moral lessons, are interpreted as neat illustrations of Freudianism. Hymen's smoking torch at the wedding of Orpheus, the flame at the altar of the festival of Venus, the winged Pagasus and Centaur Nessus have lost the poetical fancies which our early education had developed in us, but have acquired a new sex significance. Children's drawings and composition in story writing have not escaped from the interpretations of psychoanalysts. The parables and miracles of Jesus are regarded as part of the teachings of Freudian philosophy. According to its tenets, man and woman, whether they be friends, or be related by family ties in the form of father and daughter, or brother and sister, cannot meet or talk with each other without sex consciousness, and anything that either of them may see or experience in the dream state subsequently must have reference to the unconscious Id, Libido wish or intraversion and extraversion. Poor old women and fat men in dreams have their tale to tell.

Whatever one's attitude may be towards the extravagances of this new psychology and its technique, the book under review is a clear and logical presentation of all the facts of Freudianism in a simple and easily understood language. It forms an excellent introduction to the study of the bewildering psychology of the unconscious mind and provides the means for understanding in its technical terms one's own obscure and apparently inexplicable states of the waking mind and dream experiences. To a beginner commencing Freud, Faithfull's book is an invaluable guide.

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The Sesquicentenary of the Asiatic Society of Bengal.

WE take the earliest opportunity of offering our hearty congratulations to the Asiatic Society of Bengal, Calcutta, on its Sesquicentenary which it celebrated on the 15th of January 1934. This Society is, after the Bataviaasch Genootschap van Kunsten en Wetenschappen of Java, the oldest literary and scientific society in the East, being founded in 1784 by Sir William Jones. Before coming to India Sir William Jones had mastered several Oriental languages, and utilised the leisure during the voyage of six months from England to meditate, to use his own phrase, "on the eventful histories and agreeable fictions of this Eastern World". Soon after his arrival he, therefore, invited the *elite* of the European community of Calcutta to discuss the formation of a research society and as a result the 'Asiatick Society' came into being on the 15th of January 1784 with the Governor-General of India, Warren Hastings, as Patron, and Sir William Jones as President. In his first Address the scope of the Society was defined by Sir William Jones in these terms: "The bounds of its investigations will be the geographical limits of Asia and within these limits its enquiries will be extended to whatever is performed by man or produced by nature."

The meetings of the Society, in the early days of its existence, were held in the Grand Jury's room in the Supreme Court and it was not till 1808 that a building designed by Capt. Lock of the Bengal Engineers, was completed on a site granted free by the Government on the corners of the Park Street and Chowringhee; the cost of the building was defrayed by subscriptions from the members. Extensive additions and alterations have since been made to the original building, but the main structure remains as it was in 1808.

In the early years, probably owing to the backward state of Western education in India there were no Indian members of the Society, and it was not till 1832 that Dwarka Nath Tagore was elected as its first Indian member. This, however, does not mean that the Society was founded on racial or communal lines. The far-seeing founder of the Society, who envisaged a happy companionship of intellect amongst its members,

irrespective of race or creed, politics or fortune, suggested in his second Anniversary Discourse the circulation to the learned Indians of a brochure in Persian and Hindi setting forth 'the design of our institution'. The beautiful vignette, which formed the letter-head of the Society's correspondence at a later date, gives apt expression to its non-sectarian community of aim,—this latter consists of an engraving of the Vedas and a Hindu Temple on one side, of the Quran and a Mosque on the other, and in the centre is a medallion of Sir William Jones, surrounded by tropical foliage and fruit. During the last 50 years a vast development of scientific and literary research has taken place in India and as a result the European to Indian membership of the Society is now in the proportion of 2 to 3. In 1928 the membership roll of the Society was at its zenith with 602 members, but during the present year this number has decreased to about 450. We believe that this fall is due mainly to economic conditions and depression which have affected business and other activities all over the world. The Society, in addition to its regular members, has on its roll 50 Fellows elected for meritorious work in various branches of Science and Art from amongst its members, while Honorary Fellows, limited to 30, are elected from outside its ranks. There is also a class of Associate Members for including such distinguished persons as would not otherwise have joined the Society.

In the early days of the Society its meetings were confined to discussion of papers submitted to the Society, but it was soon felt that it was necessary to publish a serial publication embodying the results of the researches and the observations of its members. The name of the publication, as originally contemplated, was "Assiatick Miscellany", but in 1788 when the journal appeared, the name was changed to "Asiatic Researches". Twenty volumes of this periodical were published, but the work was not a success financially and was finally stopped in 1839. That there was a great demand for this publication is clear from the fact that more than one 'pirated' edition of it was printed—a compliment which must be rare in the bibliography of science. In 1839 a small monthly magazine was started under the title of "Gleanings in Science" and this formed a medium for the publication of monthly proceedings of the Asiatic Society of Bengal. It was edited by James Prinsep, for many years the Secretary of the Society. Its name was later changed to the "Journal of the Asiatic Society of Bengal", but it was still published by the Editors at their own risk. In 1859, however, the Society recognised the journal as an official organ of its own and took over its entire control. Seventy-five volumes of this journal were published between 1832 and 1904. In addition a second part for contributions on Natural History, Anthropology, etc., and for the proceedings of the meetings of the Society, was started in 1865 under the name of the "Proceedings of the Asiatic Society of Bengal". Of this work nearly 40 volumes were issued. In 1905 these two serials were amalgamated and the new series entitled "Journal and Proceedings of the Asiatic Society of Bengal" was started. This journal is issued as an annual volume in parts at irregular intervals during the year. In addition to the above, a special publication of quarto size, called the "Memoirs of the Asiatic Society of Bengal" was started in 1905 for publishing larger and more comprehensive articles which, on account of their size or the nature of their illustrations, are not suitable for publication in the "Journal and Proceedings". A list of papers classified according to various headings, was published in the "Centenary Review of the Asiatic Society of Bengal" in 1883, and this shows that there is practically no subject on which original researches have not been encouraged by the Society and printed in its publications. The more recent publications of the Society also show the varied activities of the Society in all branches of Literature, Arts and Sciences.

In addition to the serial publication mentioned above, the Society has published, directly or indirectly, a large number of catalogues, dictionaries and miscellaneous publications, and also a Catalogue of scientific periodicals. All these works are of very great importance and there is no doubt that no other Indian or foreign society has done so much by its publications to foster and encourage research. The most important activity of the Society, however, is "Bibliotheca Indica", a series of publications of Oriental texts in Sanskrit, Arabic, Persian and other languages and their translations. Almost 2,000 fascicles of this series have been published. In view of the above the Asiatic Society of Bengal has been rightly described as probably the largest publisher of Oriental works in the world.

The Society's library is very large, and

in round figures is estimated to contain about 100,000 volumes. It is one of the finest libraries in the East, and is particularly rich in several serial publications from all parts of the world. Financial considerations have unfortunately prevented the Council of the Society from keeping this library up-to-date within recent years, but it is hoped that funds would soon be available to fill up the lacunæ.

In connection with the work of the "Bibliotheca Indica" and in fulfilment of its special rôle in the domain of Oriental literature and its development, the Society has accumulated a very large number of manuscripts in Sanskrit, Arabic, Persian, Urdu, Chinese xylographs, and manuscripts in Burmese, Siamese, and other languages. The total number of these manuscripts is roughly about 25,000 and descriptive catalogues of various classes of manuscripts are being prepared by expert scholars at the expense of the Society. The acquisition of fresh manuscripts never ceases and thanks to the generosity of the Government of Bengal and the Government of India, the Society is able to keep its collections more or less up-to-date.

The Indian Museum of Calcutta which may aptly be described as the National Museum of the country, is a grown-up child of the Asiatic Society of Bengal. The Society started its own museum in 1814, but the collections grew so rapidly that within less than 50 years it was not found possible with its resources either to properly preserve or display the large collections in the space available in the Society's rooms. The Society persistently memorialised the Government to subsidise the establishment of a National Museum and offered to hand over its collections as a nucleus of the proposed museum. It was not till 1866 that the Society succeeded in its efforts and the Indian Museum Act was passed. The collections of the Society were handed over to the Board of Trustees of the Indian Museum and are now exhibited along with those of Government research departments—the Archæological, Botanical, Geological and Zoological Surveys most of which were also initiated through the efforts of the Society. A great part of the work of the members of these departments, and also the results of the research by various Universities and unofficial workers all over India, are still published in the publications of the Society.

The Asiatic Society is also the parent institution of similar societies in India and elsewhere. The Royal Asiatic Society of London was founded in 1823 by H. T. Colebrooke, an eminent mathematician, astronomer and Sanskrit scholar, who prior to his retirement was the President of the Asiatic Society of Bengal for 10 years and after his retirement acted as the agent of the Society in London until his death. The Bombay and Ceylon branches of the Society, founded in 1827 and 1845 respectively, were also inspired by the successful pioneer work of the Asiatic Society of Bengal.

Another activity of the Society to which special reference may be made is the Indian Science Congress which was started in 1914. This Congress, which holds its annual sessions for about a week every year in different places in India, is similar to the British Association for the Advancement of Science. Its administrative and publication work is carried on by the Asiatic Society of Bengal and it may justly be claimed that but for this *liaison* the Indian Science Congress would not have found it possible to develop at the rate at which it has done.

The Asiatic Society of Bengal has during the past 150 years done marvellous work for the development of human knowledge in Asia and has exercised an influence which may be described as second to none in any part of the world. In offering our congratulations to the Society on its Sesquicentenary celebrations we hope that its activities will continue and that it will go on flourishing and doing still more valuable work for the cause of Letters and Science in this country.

Presentation of Honorary Degrees.

AT the Sixteenth Convocation of the Hindu University, Benares, Sir P. S. Sivaswami Iyer, Sir J. C. Bose and Sir P. C. Ray were the recipients of Doctorate Degrees in Law and Science. Sir Sivaswami Iyer is a distinguished student of Constitutional Law and for his eminent service to the country deserves the high honour conferred on him. The Scientific achievements of Sir J. C. Bose and Sir P. C. Ray are too well known to be recapitulated and the degree conferred on them is an honour to the University which

can include them in its roll of distinguished degree-holders. We have pleasure in offering our felicitations to all these eminent scholars.

The Punjab University celebrated its Jubilee Convocation last month at which delegates from other Universities and Learned Societies were represented. The occasion was utilised for conferring honorary degrees on literary men and distinguished Scientists, mostly residents of the Punjab. Sir Shadilal who is an eminent Jurist and Sir Fazli-i-Hussain, the distinguished Education Member of the Viceroy's Council, received the LL.D. degree. The Degree of Doctorate of Oriental Learning was conferred on Sir Sikander Hayat Khan and Sir Sundarsingh, and the Degree of Doctorate of Literature, on Sir Mahomed Iqbal and Mr. S. C. Woolner. Rai Bahadur Professor Shiva Ram Kashyap received the D.Sc. Degree. Dr. Kashyap is a leading Botanist whose explorations of the Western Himalayan regions have added greatly to our knowledge of the flora of the ice-covered higher altitudes and the honour now conferred on him is a fitting recognition of his long and honourable service as an Educationist and Scientist. We take this opportunity of felicitating all the recipients of the Jubilee honours of the Punjab University.

Recent Advances in Anthropology, Ethnology and Ethnography in India.

By Rao Bahadur L. K. Ananthakrishna Iyer, B.A., L.T.

During the latter part of the nineteenth century, materials for the study of Anthropology, Ethnology and Ethnography were collected mostly by officials in the course of their official duties, by scholars like Dr. T. A. Wise and others, and by missionaries. Their researches were published as articles in the volumes of the *Indian Antiquary*, *Asiatic Researches*, *Calcutta Review*, *Madras Journal of Literature and Science*, *Proceedings of the Asiatic Society of Calcutta and Bombay* and in the District Manuals. Historians like Mountstuart Elphinstone, Sir H. H. Elliot and others working on the borderland of the subject preserved incidentally much material for those who would follow them. In 1872, appeared the monumental work of E. T. Dalton on the "Descriptive Ethnology of Bengal". To these were added the volumes of "The Tribes and Castes of the Provinces of India and the Indian States", all subsidised by the Government of India and the States in accordance with the comprehensive scheme of Ethnographic Survey inaugurated by the late Sir Herbert Risley. The materials thus collected belong mainly to the domain of Cultural Anthropology.

Sir Herbert Risley's "Anthropometric Statistics for Bengal", North-West Provinces (the United Provinces of Agra and Oudh), and Bombay opened new enquiries. Dr. Thurston and others in similar fields did excellent work. But Dr. John Short was the first to make systematic observations in Physical Anthropology. His methods were unsatisfactory and his achievement small. He was a pioneer, and therefore, his name should not be forgotten. The late Rai Bahadur Gupte, an assistant of the late Sir Herbert Risley, and subsequently a lecturer in the Calcutta University, did excellent work both in Physical and Cultural Anthropology. His volume on "Fasts and Festivals" along with numerous other monographs is very popular.

It is only during the last fifteen years that the enormous and invaluable mass of Anthropological materials which India offers to the student has begun to be systematically utilised. In the Calcutta University, was established, in 1921, a school of Anthropology on the model of this department in the London University with the same syllabus of study. It has been equipped with a fine library of Anthropological literature, and an excellent laboratory of up-to-date Anthropometric instruments. In this respect the University enjoys the unique distinction of being the only one, where Anthropology with all its allied subjects has been prescribed for the M.A. and M.Sc. Degree Examinations. In this connection some observations are called for as to the progress of work done by this department. On the Cultural side the present writer was the senior lecturer and Chairman of the Board of Higher Studies in Anthropology. Since its introduction in 1921–1932, apart from the lectures on the major branches of the subject, special training on research has been given by taking the students annually to the various parts of Bengal and Chota

Nagpur for a first-hand study of the aboriginal tribes in Physical and Cultural Anthropology. Their researches have appeared in the form of articles in the various current periodicals. The present writer carried during this period his studies on "The Cochin Tribes and Castes" further by the publication of the "Anthropology of the Syrian Christians," as Superintendent of Ethnography in the Cochin State, and also brought out his Readership Lectures on Ethnography. During the last six years, he also issued the three volumes of the Mysore Tribes and Castes, as Officer in Charge of Ethnographic Survey of Mysore. The final volume will be ready for publication early next year. Rai Bahadur Ramaprasad Chanda, who was a member in the Department of Anthropology, published an interesting volume on the Indo-Aryan Race. Mr. Sarat Chandra Mitra, another member in the department who retired some years ago, is a specialist on Folk-Lore. He has published his numerous contributions in the *Journal of the Anthropological Society of Bombay.* Dr. P. Mitra, who is now in charge of the department, is a specialist in Prehistoric Archæology and published a volume on the subject some years ago. Among his other contributions, he has recently published an interesting paper on "Indian Elements in Polynesian Culture," and the "History of American Anthropology". Mr. Tarak Chandra Das, another lecturer in the department, has published an interesting monograph on the Bhumjis of Mayurabhanj. He has some important papers to his credit, some of which are in the press, and will soon appear. Mr. Haren Chakladar has published a paper on the "Aryan Occupation of Eastern India". He is now studying the Fishermen on the coast of Orissa. Mr. Tarak Ray Chouduri, one of the old students and now a lecturer, has published two interesting papers, one on "the Khasias," and the other on "the Barendra Brahmans of Bengal". Mr. A. N. Chatterji who is the lecturer in Physical Anthropology trains the students in physical observations and measurements. His "First Studies on the Growth and Health of the Bengali Students" is an interesting monograph containing valuable information. It must be said in this connection, that some of the students preparing for the M.A., and M.Sc. degree examinations have contributed theses as an alternative to answering two papers; and they have, in several instances, reached a high standard. Some of the successful M.A. and M.Sc. students have been doing research work in the University under the guidance of lecturers, and have contributed valuable articles in various periodicals. Lucknow University has also introduced Social Anthropology in the curriculum of studies. The Reader who is a graduate of this University, has been contributing interesting papers on social topics to the leading periodicals.

Another important institution for research in Anthropology in Calcutta is the Indian Museum. Since the appointment of Dr. B. S. Guha, as Anthropologist to the Zoological Survey of India, a well-equipped laboratory was installed therein, and systematic researches have been taken in hand. These investigations relate to the prehistoric human and animal remains that are being excavated by the Archæological Survey in different parts of India, (1) in the Indus Valley, and (2) to the skeletal materials belonging to the various races of modern India. Lt.-Col. R. B. Seymour Sewell, Director of the Zoological Survey, who started his anthropological career in India, published his standard work on the Astragilus, while at Cambridge, collaborated with Dr. Guha in the first part of this work, and they jointly published elaborate memoirs on the Nal Skull (*Mem. Arch. Survey of India,* No. 35), the human remains excavated in Mekran by Sir Aurel Stein (*Mem. Arch. Survey in India,* No. 43), and Mohenjo-Daro by Sir John Marshall (*Mohenjo Daro and the Indian Civilisation,* Vol. II, London, 1931). The Report on the human remains excavated by Mackay in Mohenjo Daro has also been completed, and is now in the press. Of the skeletal materials of the tribes now living in India, and her frontiers, the most important work has been the publication of the study of the transfrontier Naga Crania recovered by the Dewar expedition, by Dr. B. S. Guha and Mr. P. C. Basu (*Bulletin of the Zoological Survey,* No. 1, Calcutta, 1931). Besides the contributions mentioned above, Dr. Guha who was sent to Kaffiristan to work in collaboration with the Norwegian Institute for comparative study of human cultures under Dr. Morgenstierne, has collected all available materials on the tribe before they are wiped out. His study of the Kadars have also appeared in *Nature* (May 19, 1928, and June 22, 1929). Further, his study of the Chenchus, Bhils and other aborigines, as also most of the important

racial groups in India on behalf of the Census operations will give a connected account of the racial history of India. It must also be said in this connection that the students of the University working under him in Physical and Cultural Anthropology have produced excellent monographs.

Dr. Hutton, Honorary Director of the Ethnographical Survey of Assam, and the Census Commissioner for India, has made very important contributions to the Cultural Anthropology of India. Besides being the author of two excellent monographs on the Angami and Sema Nagas, his Report on the Census of India, Vol. I, Part I, is a monumental work. Mr. Mills and other colleagues of his in Assam have been issuing individual monographs on the aboriginal tribes of Assam, all of which form very important contributions to the Social Anthropology of India.

Dr. Baron Egon von Eickstedt, Leader of the Saxon Institute, Leipzig, came to India in 1926. He has made an intensive study of the aboriginal tribes, and castes of India, and the Indian States, and took measurements of the types and as many as or even more than 7,000 photographs. After his return to Germany, he made use of his materials, and published the two volumes on *Rassenkunde und Rassengeschichte* (History of Mankind). His Racial History of India is a valuable contribution to the Science of Anthropology.

Rai Bahadur Sarat Chandra Roy, M.A., B.L., M.L.C., Editor of "Man in India", is an indefatigable student of Anthropology. Besides being the author of several volumes (Orans, Mundas, Birhors), his Journal contains excellent articles relating to India.

Thus far we have been dealing with the anthropological activities in the two institutions of Calcutta, and those outside it. The Anthropological Society of Bombay is the only institution of its kind, on the West Coast. It has been long in existence, and its contributions form valuable additions to the Cultural Anthropology. Dr. Ghurye, who is the Reader in Sociology, Bombay University, has recently published an interesting volume on "Race and Caste" in addition to his other contributions on social topics.

It will not be out of place in this connection to mention the names of Mr. G. S. Sitapati, B.A., Sasankasekhara Sarkar and L. A. Krishnan. The former was a research scholar of the Andhra University, made a first-hand study of the Sauras of the Ganjam and Vizagapatam districts, the second of the Malpaharias of the Rajmahal hills, and the third of the aborigines of Travancore. The manuscripts of the first two when published will form excellent monographs; and the researches of the third have already appeared in the *Travancore Census Report*. All the scholars were working under my guidance.

In the Presidency of Madras with one old and two infant Universities the importance of anthropological research for which there is ample scope, leaves very much to be desired. Dewan Bahadur K. Rangachary, once an assistant in the Madras Government Museum under Dr. Edgar Thurston, recently published a monograph on the Sri Vaishnavas. The present assistant Mr. Iyappan is contributing some articles which are published in the Museum Bulletins. The Mysore University has revived the Ethnographic Survey of the State, the three volumes of which, dealing with the descriptive account of tribes and castes, have been already published. The final volume will appear early next year. But there still remains another side of the subject for which anthropometric survey is necessary. As a premier and very enlightened State in India in point of culture, it is hoped that the Mysore University will be the centre of research in South India, as Calcutta is in the North. Besides the University, the Mythic Society of Bangalore helps research by its monthly meetings and valuable contributions in its journal.

Last but not the least, is the part played by the subject of Anthropology (Physical and Cultural) in the Indian Science Congress, an organisation for the advancement of Science in India, in all its branches, like that of the British Association in England. It has been meeting at the different University Centres. The Anthropological Section was presided over by the leading Anthropologists whose presidential addresses, and the papers read during its sittings, and their publications in the annual reports are extremely valuable contributions to stimulate the study of the subject.

From what has been said, it may be seen that much has been already done on the subject. But it must be remembered that India is a vast sub-continent, and that a great deal more remains to be done by way of collecting materials from unexplored regions of which there are many, like Travancore, Coorg, portions of Telugu districts and many

more in South India as well as those in the North. The workers are still very few. A band of young men must be trained in Universities on the various departments of the study of man, and sent out to collect materials from hitherto unexplored fields. Scientific work of this nature can be best done only by Universities which would give it, its proper place in the courses of studies. The Science of Anthropology with its many approaches and aspects will afford abundant opportunities for original research.

Polymegalous Spermatids in a Grasshopper.

By T. Ramachandra Rao,

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THE studies of Paulmier,[1] Zweiger,[2] Davies[3] and others have shown that in certain insects the spermatids exhibit double and quadruple complements of centrosomes, as a result of pathological dimegaly or polymegaly. The sizes of these abnormal spermatids vary according to the number of centrosomes present. Montgomery[4] has also described in *Euschistus* that the same testis produces sperms of three sizes varying with their positions in particular follicles. His observations have been confirmed by Bowen[5,6,7] who has studied a large number of Pentatomids.

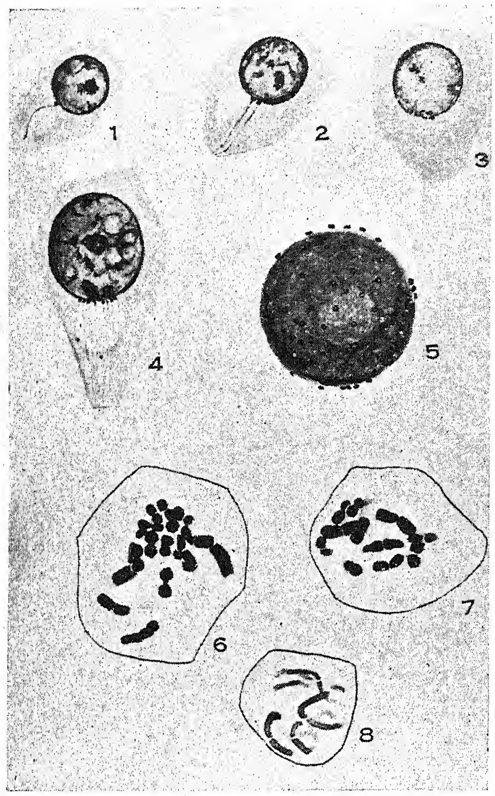
Two explanations have so far been offered for the occurrence of these abnormal sperms. For those of the first kind, *i.e.*, those with 2 or 4 centrosomes the usual explanation is that they are due to the suppression of one or both of the spermatocyte divisions. Wilson[8] writes: "It is practically certain that the double forms are due to a suppression of the second spermatocyte division, the quadruple ones to a suppression of both the divisions in respect to all the sperm-forming elements excepting the centrioles and the chondriosome apparatus. The latter have completed their allotted number of divisions and subsequent differentiations." Cannon[9] has discovered atypical sperms in the louse which he says are regularly provided with two axial filaments; Bowen suspects that here also the two tail filaments may arise from doubled centrioles, since in these forms only one spermatocyte division is said to occur.

The explanation offered for the polymegaly in Pentatomidæ is a physiological one. Montgomery suggested that the size differences may be due to variations in nutritional factors though the exact sources of these variations have not been traced. Bowen's view in respect to this is that the number of centrosomes varies with the size of the cytosome. Similar studies in plants of giant sperms have yielded very interesting observations, especially in the gigas forms of Solanum where the abnormal size of the pollen as well as of certain cytoplasmic inclusions were directly attributed to the tetraploid nature of the nucleus (Winkler).[10] Gates[11] has also come to similar conclusions in Oenothera. The experiments of Boveri, the Marchals and others have also led to similar conclusions, namely, that the size of a cell varies with the number of the chromosomes which enter into the constitution of the nucleus. The present position, as briefly stated above, shows that the problem is many-sided and requires further study.

In my study of the spermatogenesis of Pyrgomorphinæ I have come across certain giant spermatids which seem to provide us some interesting information. Fig. 1 shows a normal spermatid of *Aularches*. Here the nucleus is seen to have on one side a centrosome from which has arisen a tail fibre which bends around a mass of clear substance and is apparently attached to another dark body which may correspond to the centrosome derivative migrating to the periphery

1 Paulmier, F. C., *Journ. Morph., Suppl.*, **15**, 1899.
2 Zweiger, *Zeit. F. Naturw.*, **42**, 1907.
3 Davies, H. S., *Bull. Mus. Comp. Anat. Harvard*, 1908.
4 Montgomery, T. H., *Zool. Jahrb.*, 1898.
Montgomery, T. H., *Arch. Zellforsch.*, 1910.
5 Bowen, R. H., *Proc. Amer. Acad. Arts and Sci.*, **57**, 1922.
6 Bowen, R. H., *Biol. Bull.*, **42**, 1922.
7 Bowen, R. H., *Journ. Morph.*, **39**, 1924.
8 Wilson, E. B., *Cell in Dev. and Inherit.*, 1925.
9 Cannon, H. G., *Quart. Journ. Mic. Sci.*, **66**, N. S., 1922.
10 Winkler, *Zeit. Bot.*, **8**, 1916.
11 Gates, R. R., *Bot. Gaz.*, **44**, 1909.

observed by Johnson.[12] The material used in making preparations from which the figures were drawn was fixed in Bouin's fluid and stained in Iron Hæmatoxylin and was specially prepared for chromosome studies. Hence it is interesting to observe the "nebenkern" in them. The recent discussions of Baker[13] and others have shown that mitochondria may be preserved



× 900

in Bouin preparations and my slides offer confirmation of Baker's views, especially after staining with Altmann's triple with a previous treatment with potassium dichromate. Fig. 2 shows a spermatid with two centrosomal bodies from which two tail fibres have arisen. The size of the cytoplasm as well as of the nucleus is larger. Fig. 3 is that of a spermatid with four centrosomes and the size of the cytoplasm and the nucleus has increased proportionately. The double and the quadruple centrosomes have been reported by Davies in grasshoppers where he says they occur rarely. In my preparations they are very common; but spermatids such as are drawn in Figs. 4 and 5 have not been reported in grasshoppers and no mention of such forms in other animals has come under my notice. Fig. 4 shows a giant spermatid with a large nucleus and eight centrosomes attached to one of its sides. Tail fibres are seen arising from them. The "nebenkern" too has grown to a considerable proportion. Fig. 5 is that of another giant showing a very large nucleus surrounded by a large number of centrosomes (as many as 48). This figure is a composite drawn from three consecutive sections into which the nucleus has become divided. This spermatid seems to be in a slightly later stage of development as can be seen from the size of the individual centrosomes. Unfortunately, I could not trace any tail fibres in this spermatid or in others of similar size and constitution. It is obvious from such forms that polymegaly here is not due to a mere suppression of the two spermatocyte divisions, for in that case, we should meet only with two or four centrosomes. They confirm to some extent the opinion of Bowen that the cytosome as well as its components vary with the size of the nucleus, however induced. The main question now is how exactly the abnormal size of the nucleus has been brought about. While in plants the *gigas* forms are known to be due to increase in the chromosome numbers, the polymegalous spermatids of animals have always been regarded to be diploid in their chromosome constitution. If so, the large forms (Figs. 4 and 5) are indeed very extraordinary, the chromatin having increased enormously and the usual chromosome number being retained.

I wish to record here certain cells in the testes of *Aularches* which seem to possess some bearing on these problems but which are not yet quite clear as to their exact significance. Figs. 6 and 7 are two cells in which may be seen apparently the diploid number of chromosomes in each of which can be noticed a transverse fissure, scattered in the cell without any definite orientation. They are cells which belong to cysts containing spermatids some of which seem to be normal and some to possess a larger size. Unfortunately the centrosomal bodies cannot be observed in these cysts; otherwise a definite relationship with the polymegalous forms could have been established. But the larger size of some spermatids in these cysts

[12] Johnson, H. H., *Science*, **56**, 1922.
[13] Baker, J., *Nature*, Nov. 12, 1932.

do indicate a sort of bearing on this question. The size relations of the chromosomes of these cells show almost the same features as seen in the normal spermatogonial metaphase where can be observed nineteen telomitic rod-shaped chromosomes. The transverse fissure in each chromosome is very difficult to explain. It may be due to either a division in the transverse plane of the chromosome or to the association of two separate chromosomes. In the first case, a transverse division will have to be accepted which is opposed to all known forms of normal mitosis. In the second case, the existence of tetraploid cells must have to be accepted in which the two spermatocyte divisions are suppressed and the homologues approach one another for a very belated association. The latter postulate, if true, is also very peculiar in that the chromosomes seem to be associated end to end which is quite different from the normal parasynapsis characteristic of all grasshoppers. Such transverse fissures can be observed even in slightly earlier stages of these abnormal cells as may be seen from Fig. 8 which shows a cell with a few of these chromosomes not yet condensed completely. The exact relationship of these cells with the giant spermatids remains to be determined.

Obituary.

Sir Alexander Houston.

BY the unexpectedly early passing of Sir Alexander Houston, the world will miss a great public servant and a finely tempered intelligence.

Having been privileged to maintain a friendly correspondence with him since the beginning of the present century, it seems right that I should add a brief tribute to his memory, with special reference to the bearing of his work on the purity of Indian water supplies.

We first became acquainted when he was engaged in studying the bacteriology of sewage treatment on behalf of the Royal Commission on Sewage Disposal.

This work was a fitting preparation for the great responsibility which later devolved upon him of safeguarding the London water supply as Director of Water Examination, Metropolitan Water Board. Annually for 27 years his Reports appeared, models of detailed and laborious investigation combined with a wide and sane critical judgment, the whole presented with a literary charm which held the interest of the ordinary citizen, for whose ultimate benefit the work had been done.

Among the outstanding results of his scientific studies may be mentioned an increased knowledge of intestinal flora and of the effect of storage on the viability of these forms of bacterial life.

This line of research was followed up by Clemesha in its application to Indian conditions, with important results in practice.

The influence of Indian sunlight on the bacterial population of reservoirs was observed in the rapid but selective elimination of organisms indicative of recent pollution.

Comparatively short periods of storage effect great improvement. Careful observations in the early days of the scientific control of the water supply of Jamshedpur, where conditions are exceptionally difficult, and where, as in the case of Shanghai, it was necessary to use a river polluted with sewage as a source of water supply, showed that 5 days storage was sufficient to bring about the "safety change".

The use of Chlorine as a final agent in water purification, now well known in India, owed much to Houston's initiative. He was, however, always ready to consider new methods and of late years had renewed his interest in Ozone, the use of which as an alternative to Chlorine had again become possible in many cases owing to the cheapening of electrical power. He was impressed by the freedom from taste troubles attending its use, and also by its remarkable decolorizing efficiency.

The curious "Catadyn" process, depending on the oligodynamic effect of finely divided silver, did not escape his attention.

That for more than a quarter of a century the vast and increasing population of Greater London has been practically free from waterborne disease, is sufficient tribute to the vigilance of this wise, simple and scrupulously faithful guardian.

This and the love and esteem of all who knew him have been his reward.

Central Hotel, GILBERT J. FOWLER.
Bangalore.
December 1933.

Letters to the Editor.

Fixation in Vacuo.

FOR rapid and successful fixation it is necessary that the materials should sink in the fixing fluid very quickly. For this it often becomes necessary to exhaust the air with an air-pump after placing the material in the fixing fluid. But in majority of cases the fixation must be done in the field and the ordinary air-pump is an inconvenient piece of apparatus to carry. To obviate this difficulty Osterhout[1] recommends a simpler form of air-pump, but the one we are using in the Presidency College Laboratory is not only very convenient to carry (total length being 5½″, Fig. 1) but is giving uniformly satisfactory results and can be made very easily at a nominal cost. As cytological investigations have been taken up by a large number of investigators all over India, we give below a description of the apparatus.

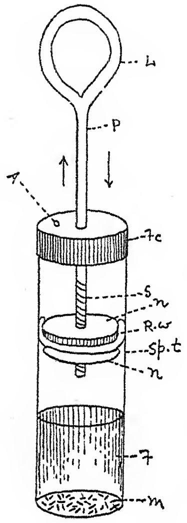


Fig. 1.

F—Fixing fluid.
m—Materials.
n—Brass nuts.
Sp.t—Specimen tube (3″×1″)
Fc—Fibre cap.
R.w—Rubber washer held in position by two brass nuts.
A—Air hole.
P—Piston.
L—Loop.
S—Screw (cut on the brass rod).
↓↑—Arrow heads show the working.

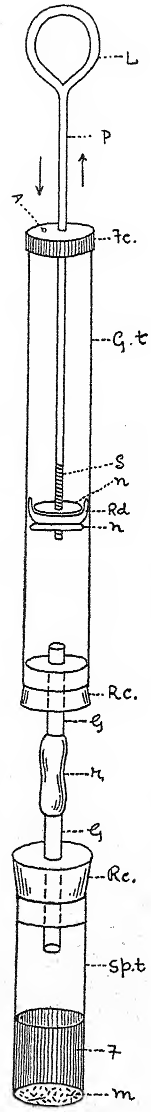


Fig. 2.

m—Materials. *F*—Fixing fluid. *Sp.t*—Specimen tube. *Rc*—Rubber cork. *G*—Glass tubing. *r*—Rubber tubing. *n*—Brass nuts. *Rd*—Rubber washer held in position by two brass nuts. *S*—Screw (cut on the brass rod). *Fc*—Fibre cap. *A*—Air hole. *P*—Piston. *L*—Loop. *G.t*—Stout glass tubing (8″×¾″).

Figure 1 shows the construction of the pump in detail. The tube is an ordinary 3″×1″ specimen tube. The piston consists of a brass rod (⅛″ in diameter), one end of which is made into a loop and the other end is provided with a screw thread; the rubber washer, cut to size, is kept in position by two brass nuts, the lower one of which is slightly smaller than the inside diameter of the tube. The fibre cap contains two holes; the central one for holding the piston in position and the other one for the air to come out while the piston works.

The working of the apparatus is very simple. Take out the piston with the cap; pour the fixing fluid in the tube, then the material. Replace the cap with the piston and work it. The advantage is that the same apparatus can be used over and over again, for the fixing fluid with the sunk materials can be removed to smaller specimen tubes.

We have also devised an universal pump which can be used with any specimen tube. In this case the piston arrangement is the same as in the first case, but a piece of stout glass tubing about 8″ long and ¾″ in diameter is taken instead of the specimen tube. At one end of this tube the piston with the cap is fixed and at the other is fixed a rubber cork with a piece of glass tubing as shown in Figure 2. During fixation a series of specimen tubes of the same diameter is taken in all of which a single rubber cork with a piece of glass tubing of the same bore as the one used in the piston fits. When in use the ordinary cork of the specimen tube is replaced by this rubber cork and a short piece of

[1] Osterhout, W. J. V., "Contributions to Cytological technique", *University of California Publications* (Botany), 2, No. 2, July 15, 1904, pp 78-80.

stout rubber tubing makes the connection between the air-pump and the specimen tube.

As to the efficiency of the apparatus the vacuum produced in the smaller pump (Fig. 1) after a few strokes, is of the order of about 10 to 12 cm.; in the universal one (Fig. 2) it is of a higher order. The vacuum produced helps the sinking of the material in two ways:—(1) by expelling the air between the surface of the fixing fluid and the uneven surface of the material, and thus helping it to "get wet" soon; and (2) by extracting the enclosed air within the material itself, thus making it "heavier" and readier to sink in the fixing fluid. It is our common experience that materials sink in the fixing fluid within a minute of the working of the pump.

Figure 3 shows a photomicrograph of a stage in meiotic mitosis in the microsporogenesis of *Hibiscus mutabilis*—all the buds of

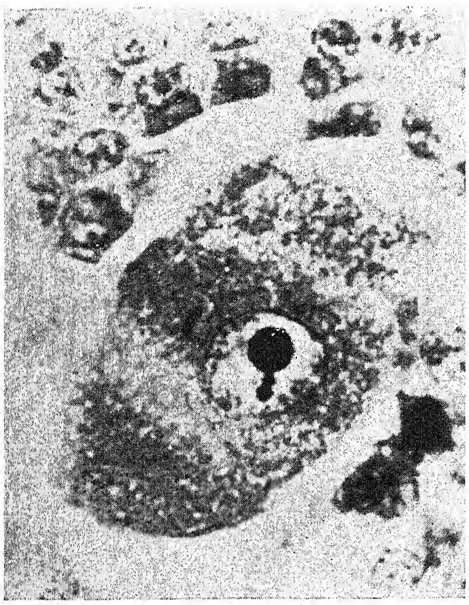


Fig. 3.

Photomicrograph of a pollen mother cell showing the fragmentation of the nucleolar bud in the nucleus.

which were fixed in the field with the help of these pumps. The detailed investigation of this material will form a separate paper.

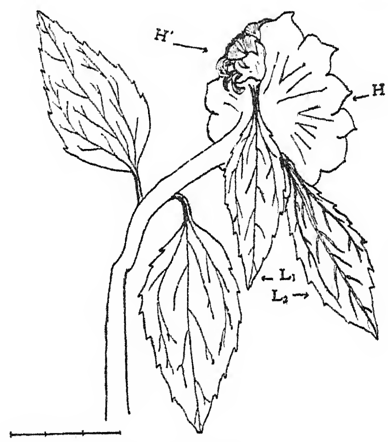
ROBINDRA MOHON DATTA.

Department of Botany,
Presidency College, Calcutta,
October 15, 1933.

An Interesting Case of the Insertion of the "Leaves and Head" in *Helianthus annus*, Linn.

It is a point of every-day observation that cauline leaves arise at the nodes of a stem and the radicle leaves appear to grow directly from the root or the roots, but are borne by the reduced stem. A slight deviation from this usual mode of insertion has been observed recently in *Helianthus annus* under cultivation.

The plant is about two feet in height and bears at the top a small head-inflorescence (see text-fig. H). The plants of this species usually grow to six feet and



Helianthus annus, Linn.

bear a few axillary and terminal heads. In the case under consideration, the growth is stunted. The head mentioned above is drooping towards one side as it is sufficiently old. The lower part of the involucre, therefore, is exposed towards the sky and bears two foliage leaves (L_1 & L_2) opposite to one another. In the axil of one of these, is another smaller inflorescence (H′) just opening. The point of insertion is fairly above the peduncle, which usually bears the leaves. Seeing that the flattened portion of the peduncle on which the leaves and the inflorescences are growing is a modification of the stem, there is certainly no point of wonder in the above phenomenon; but the fact that it is of unusual occurrence is a point of interest.

S. A. PARANDEKAR.

Biology Department,
Rajaram College,
Kolhapur,
November 8, 1933.

The Velocity of Light.

AT the end of the year 1928, when Michelson had finished his classical experiments, my attention was diverted to the experimental results obtained about the Velocity of Light, that seemed to show a kind of regular decrement.

I have given below the results of the determination of the velocity of light as given by De Bray (*Nature*, page 522, April 4, 1931):—

Year	Authority	Velocity
1902–4	Perrotin	299,901 ± 84 K.M./Sec.
1924–6	Michelson	299,802 ± 30 K.M./Sec.
1926	Michelson	299,796 ± 4 K.M./Sec.[1]
1928	Karolus & Mittelstaedt	299,778 ± 20 K.M./Sec.[2]

De Bray pointed out in *Nature* (April 4, 1931) that the results obtained by different observers show a decrement in the velocity of light. The graph of the results obtained by Michelson also seems to show a similar variation.

Vrkljan (*Zeit. f. Phys.*, **63**, 688, 1930) has proved that according to the General Theory of Relativity of Einstein the decrement in the velocity of light is possible.

On the basis of the experimental results and some theoretical considerations based on the General Theory of Relativity and the Theories of the Expanding Universe, that has been up to this time neglected, *it seems most probable that the velocity of light in the Universe is decreasing.* It seems strange that up till now no attempt has been made to reconcile the results obtained by different investigators as regards the decrement in the velocity of light. The considerations of the Theory of Lemaitre and the General Theory of Einstein lead us to this inevitable conclusion that the Velocity of Light is decreasing from day to day, although very slightly, and this is the property introduced owing to the Expansion of the Universe. A detailed Mathematical account will be published in the *Indian Journal of Physics* and the *Physical Review*.

DR. M. ALARABY.

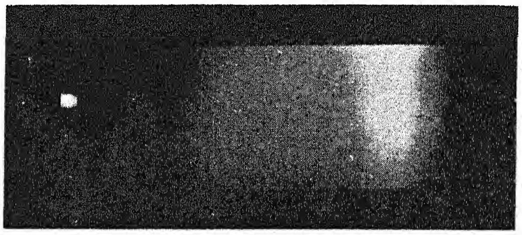
Lyceum,
Arrah, B. & O.,
November 12, 1933.

[1] Mt. Wilson Contr., 1928.
[2] *Phys. Zeit.*, **29**, 698, 1928.

Incoherent Nature of Phosphorescent Radiation.

IN a recent communication[1] we reported about the incoherent nature of the fluorescent radiation. It is perhaps of interest to enquire as to whether the phosphorescent radiation is incoherent like the fluorescent radiation or not.

So we recently repeated the experiment using a zinc sulphide screen in place of the cell containing the fluorescent solution and λ 3650 group of lines filtered out of the mercury arc with a "Corning glass filter". The screen was prepared in the following way—a glass plate was coated on one side with a thin film of water-glass. Over this film fine powder of zinc sulphide was spread till there was an uniform layer of the sulphide. We reproduce here the print (slightly enlarged) of the spectrogram we



obtained. This shows the *incoherent* nature of the radiation.

S. M. MITRA.
P. L. MUKHERJEE.

Physics Laboratory,
Dacca University,
December 7, 1933.

Studies on the Chromosomes of Indian Orthoptera.

IV:—The Idiochromosomes of Hierodula species (?) (Mantidæ).

SEVERAL interesting forms representing the families Mantidæ and Phasmidæ are not uncommonly met with in the vicinity of the Ismail College, Jogeshwari, situated in the Salsette district about 20 miles north of the City of Bombay. So far as the writer is

[1] *Cur. Sci.*, **2**, 126, 1933.

aware, barring three papers[1] published prior to 1912 and which are not easily accessible, no work has been done on the chromosomes of the above-named families of Orthoptera. In the present study on the meiosis as witnessed in the growing testis of Hierodula the writer has succeeded in making out not only the usual features such as the chromosome numbers, etc., but three peculiar idiochromosomes which can certainly be looked upon as sex-determinants.

Only the very minute testes of the earliest instar stages of Hierodula can reveal the diploid number of chromosomes. On the equatorial plate of a dividing spermatogonium at the metaphase 27 chromosomes are observed, 24 of which form 12 pairs of autosomes, which are all rod-shaped and vary in length. The remaining three, as subsequent observations show, are sex-determinants or idiochromosomes. Two of these three are very large, the largest of all chromosomes are almost always curved like V and lie always in the peripheral part of the equatorial plate. The remaining idiochromosome is the smallest of the three, almost dot-like and has no definite location on the spermatogonial spindle.

The most interesting feature in the meiosis is the form and position taken up by these three peculiar sex-determining chromosomes on the spindle at the metaphase of the primary spermatocytes. The two V's become large L-shaped chromosomes, and as seen in a tangential view of the spindle they lie side by side, though not connected with each other. They both are always directed towards one and the same pole, their longer arms lie parallel and the shorter arms at an acute angle with the axis of the spindle. The smallest of the three idiochromosomes appears at this stage almost as a small point and is directed towards the opposite pole and is united by a very thin thread to the longer arm of one of the L-idiochromosomes as shown in the diagram.

It is of interest to note that this smallest member of the group of idiochromosomes in the Japanese form worked out by Oguma[1(c)] is fairly large, almost half the size of the other two idiochromosomes.

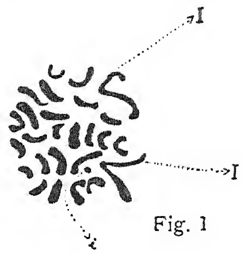


Fig. 1

Fig. 2 (a)

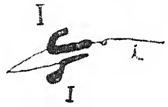


Fig. 2 (b)

Explanation of figures:—Drawings were made with a camera lucida, at a level about 4 cm. below the microscope stage. The optical combination was a Zeiss $^1/_{12}$″ oil immersion objective, N.A. 1.25; Zeiss compensating ocular, K × 15; and Leitz aplanatic sub-stage oil-immersion condenser, N.A. 1.4.

Fig. 1. Polar view of spermatogonial metaphase chromosomes, 27 chromosomes; 'I', 'I' and small 'i' are three Idiochromosomes.

Figs. 2(a) and **2(b).** Tangential views from two different cells of all the three Idiochromosomes at the metaphase on the primary spermatocyte spindle. Other chromosomes, autosomes, have not been drawn. The two large Idiochromosomes, 'I' and 'I' go towards one and the same pole, the small dot-like chromosome, the small 'i', is drawn towards the opposite pole.

In the ensuing anaphase of the reduction division the two L-shaped major sex-determinants always go towards one pole, while their associate, the smallest idiochromosome, is drawn towards the opposite pole. Thus are produced two classes of secondary spermatocytes. Their chromosome contents as seen on the equatorial plate of the metaphase are: (1) 12 autosomes+2 Ls (two major parts of the idiochromosome complex); (2) 12 autosomes+a small dot-like chromosome (the smallest of the sex-determinants).

An attempt is being made to investigate the form, structure and behaviour of these peculiar idiochromosomes (sex-determinants) in a few forms of insects representing some groups of Mantidæ.

J. J. ASANA.

Ismail College,
Jogeshwari, Bombay, S. D.
December 7, 1933.

[1] (*a*) Giardina, 1897; as quoted by E. B. Harvey in her paper "A review of the chromosome numbers in Metazon," Part I. *Journ. of Morphology*, **28**, 1916.

(*b*) Sinety, R., 1901, *Recherches sur la biologie et l'anatomie des Phasms*, La Cellule, **19**.

(*c*) Kan Oguma, 1912, "The Idiochromosomes of the Mantis," *Journ. of the College of Agriculture*, Hokkaido Imperial University, **10**, Part I.

A Specific Colour Inhibitor Gene in Rice.

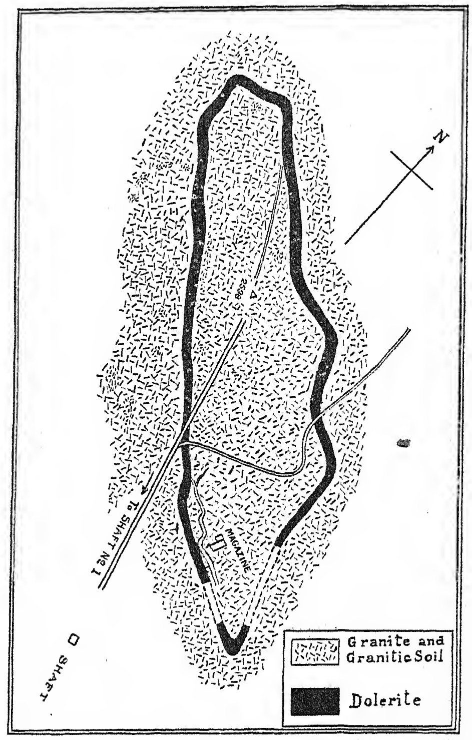
CERTAIN varieties of rice are characterised by the presence of anthocyanin pigment all over the plant. The red colour in the presence of chlorophyll imparts a dark purple appearance. Inheritance studies by Kato and Takezaki show that the coloured condition is dominant to the green and in F_2 there is either a complementary digenic or a trigenic segregation.[1] The writer by crossing a purple rice variety with an entirely green type obtained in F_1 green-leaved plants with red sheath. In F_2 green and purple-leaved plants were obtained in the proportion of 13 : 3. The F_2 green plants were of two kinds—with red sheath and without. In F_3 the entirely green plants bred true; those that had red sheath either behaved pure or split in the monogenic ratio of 3 green : 1 purple or repeated the F_1 performance. The purples either gave only purple progeny or split in the proportion of 3 purple : 1 entirely green. Thus the F_3 behaviour was in conformity on the basis of an inhibitory gene effect. In addition to above, analysis of other gene functions show that a major gene is responsible for producing anthocyanin pigment all over the plant. Its action, however, is checked in the leaf region by a partially epistatic gene, resulting in plants with green leaves but with red sheath. When the specific inhibitor is absent the plants are entirely purple as the anthocyanin gene is able to extend its influence in the leaf region also.

B. S. KADAM.

Rice Breeding Station,
Karjat, Kolaba, B. P.
December 15, 1933.

On the Occurrence of a Ring-Dyke near Hulikere, Mandya Taluk, Mysore.

THE object of the present communication is to draw attention to the occurrence of a ring-dyke of dolerite near Hulikere (Mandya, Mysore District), the site of the well-known tunnel works. While searching for a suitable material which could be used for lining the tunnel, this dolerite dyke was located; and in view of the rock being eminently suited for this purpose and the close proximity of the occurrence to the works (about a furlong north of the main shaft) the engineering department have quarried large amounts of this rock all along the dyke. In the course of this work, it was found that, unlike the usual rectilinear form of dykes, this dolerite dyke was more or less elliptical and completely enclosed a large area of the country rock, which here is a granitic gneiss. A map of the dyke with the country rock is shown in the accompanying figure. The longer axis of the ellipse (formed by the dyke) is



Ring-Dyke at Hulikere.

about 3,000 feet and the shorter axis reaches a maximum of about 750 feet. The dyke itself varies from 30 to 50 feet in width.

The dyke material is uniform throughout its length and may be described as a compact and fine-grained dolerite. Under the microscope, the rock shows plenty of more or less uralitising augite with a sub-ophitic relation to the plagioclase.

We consider the occurrence of this ring-dyke as of great interest, since this is only the second example of its kind in India, the

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[1] Ikeno, S., "Eine Monographie über die Erblichkeitsforschungen bei der Reispflanze," *Bibliogr. Genetica*, 3, 245–312, 1927. (Translation by the Imperial Bureau, Plant Genetics. Cambridge.)

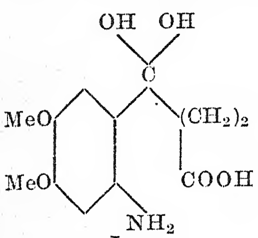
first being the one described some years back from the Girnar Hills in Kathiawar.[1]

M. R. KRISHNAMURTHY RAO.
C. PRASANNAKUMAR.
M. R. SRINIVASA RAO.
Department of Geology,
Central College, Bangalore,
December 21, 1933.

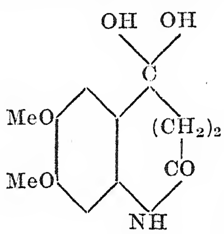
β-6 amino 3 : 4 dimethoxy benzoyl propionic acid.

IN a recent communication, Miki and Robinson (*J.C.S.*, 1933, p. 1467) have made certain observations regarding a paper by Haq, Kapoor and Ray (*J.C.S.*, 1933, p. 1087) which call for an immediate reply.

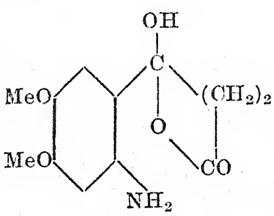
The nitration of 3 : 4 dimethoxy benzoyl propionic acid was found by the latter authors to give a nitro acid, m.p. 212°, which Miki and Robinson confirm. But Haq and co-workers obtained an amino acid (isolated at 0°) by the reduction of the nitro acid which they state melts at 118° whilst Miki and Robinson find the m.p. to be 142°. We have re-examined the products and are able to state that Haq, Kapoor and Ray's acid is an amino acid of the constitution (I) whilst Miki and Robinson's product seems to be II or II B and is not an amino acid at all.



I



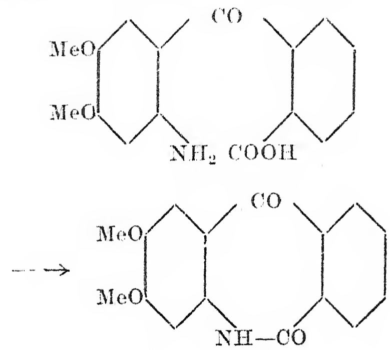
II



II B

Haq, Kapoor and Ray's product gives a clean diazo reaction whilst Miki and Robinson's does not and is insoluble in cold bicarbonate solution. Moreover, the latter compound, on interaction with nitrous acid, gives a greenish (nitroso ?) compound.

It is not surprising that a keto-acid should have a molecule of water of constitution as depicted above, since numerous examples of a similar kind can be cited from literature. The formation of a seven-membered ring is not so unusual in such a case and a recent investigation in this Laboratory has shown that the corresponding amino acid III, readily passes into the related lactam. A lactam of this type has also been prepared by the Beckmann change of the oxime of anthraquinone (*Ber.*, **59**, 1923, 16).



III

Therefore, Miki and Robinson's experiments on the synthesis of quinolines, the fission of the seven-membered ring (or the Lactone) by alkali in alcohol preceded condensation with acetone but in the case of acetaldehyde, the speed of interaction of the latter substance with alkali is far greater than the ring opening of the lactam resulting in the total loss of acetaldehyde, as indeed, has been found by Miki and Robinson.

Miki and Robinson are of opinion that, in the experiments of Haq, Kapoor and Ray, there has been a loss of acyl groups when the amino acid is condensed with acetyl acetone and dibenzoyl methane, and they state that "carbon and hydrogen estimations are required in order to confirm the view taken of the constitution of the products." On page 1089 of Haq, Kapoor and Ray's work, a carbon and hydrogen estimation of acetyl-acetone condensation product is actually described which does not bear out the suggestion that a loss of an acyl group has occurred. However, if Miki and Robinson's contention is correct, then the products from dibenzoyl methane and acetophenone should be identical. We have confirmed our finding that they are not identical, since a mixture of the two substances melts indefinitely from 171°–197° and moreover,

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[1] K. K. Mathur and others, "Magmatic Differentiation in Mount Girnar," *Journal of Geology*, **34**, 4, 1926.

the two substances are strikingly different in their physical and chemical properties.

Further, the compound, m.p. 141°, isolated by Haq *et. al.* from acetaldehyde does not give a diazo reaction and therefore cannot be the unchanged amino acid as conjectured by Miki and Robinson. There is an error in the description of the compound which we shall correct later.

A more detailed report on the subject will appear shortly but we desire to state that we were quite unaware that Miki and Robinson had started the investigation as we can find nothing in their published work to suggest it.

M. A. HAQ.
J. N. RAY.

The University,
Lahore,
December 28, 1933.

The Mechanism of the Coagulation of Colloidal Solutions.

THE chief characteristic of colloids is that their properties depend to a large extent on the degree of dispersion. Flocculation or the coalescence of the colloidal particles brings about a decrease in their number and an increase in the size of the aggregates. This is usually called coagulation and it is of great interest to colloid chemists as well as to soil and industrial chemists, and hence the investigation of its mechanism deserves particular attention. In spite of the great deal of research that has been carried out by a number of workers, the exact nature of the changes taking place in these disperse systems during coagulation is still very imperfectly understood. With a view to throw further light on this problem we commenced about two years ago a series of investigations, and a brief account of some of the results obtained by us is given below. The experimental procedure was to follow the changes in the electrical conductivity of mixtures of colloidal solutions and coagulating agents (electrolytes or sols with oppositely charged particles) with time and with the variation in the concentration of coagulators and to further examine the coagulating sols in the ultramicroscopic field. Several sols have thus been examined.

The conductivity of arsenious sulphide sol, when exposed to ordinary light, increases with time fairly rapidly at first and slowly afterwards. This has been observed previously by Murphy and Mathews (*Jour. Amer. Chem. Soc.*, **45**, p. 16, 1923). Even in the dark a slow increase was observed, apparently due to a chemical reaction, which was accelerated by light. It was therefore necessary to carry out the investigations with this sol without exposing it to light at all. In the dark the conductivity of this sol was found to decrease steadily with time during coagulation by solutions of $FeCl_3$, $BaCl_2$ and KCl of suitable concentrations. (In order to observe the effects described in this paper it was found necessary to use solutions of such a concentration, which was low but sufficient to bring about coagulation.) The ferric ions were found to be the most effective in causing a decrease in conductivity and also coagulation, barium ions were less effective and potassium ions the least. In the case of ferric hydroxide sol (positive) ions of higher valency like the sulphate ions were found to be more effective than the univalent ions. Further, it has been found that in the case of the coagulation of arsenious sulphide sol the conductivity decrease is gradual and takes place in the course of several hours, commencing before coagulation has set in and continuing for some hours and, when ferric ions are used, being noticeable long after complete coagulation has taken place; but in the case of the coagulation of ferric oxide sols the decrease in conductivity is very rapid, being practically all brought about within one or two minutes after the addition of the coagulating electrolyte, and is then more or less constant. It is thus clear that there is no parallelism between the course of coagulation and the change in conductivity. The latter is always observed first and is clearly due to the changes in the ionic atmosphere round the colloidal particles which reduce their charge and cause their coalescence.

It will be of interest to examine critically the nature of the ionic changes taking place in the colloidal solutions on the addition of the coagulating agents. In the first place, there is, in many cases, an interaction taking place between the stabilising ions of the colloidal micells and the ions of the added electrolyte. This removal of the stabilising ions causes a destabilisation of the colloidal particles. This, however, takes place only in those cases where such an ionic reaction is possible. Secondly, there is very often an exchange adsorption, whereby the ions in the outer part of the double layer round the colloidal particles are displaced by the added ions of a like charge, having a higher valency.

This was observed by Linder and Picton (*Jour. Chem. Soc.*, 87, p. 1908, 1905) and confirmed by the recent researches of Rabinavitz, Weiser and others. This exchange adsorption causes a decrease in the charge of the colloidal particles. In those cases where both the above-mentioned changes are likely to take place simultaneously, very small concentrations of the added electrolyte bring about a rapid and complete coagulation of the colloid. These are the changes, which are responsible for the decrease in the conductivity observed before the commencement of the coagulation. If the quicker of these two processes is much more effective than the other in causing coagulation, we find a very rapid decrease in the conductivity on the addition of the electrolyte, after which a practically constant value is attained or a slight change is observed, as in the case of the coagulation of ferric hydroxide sols. On the other hand, when the slower process is more effective than the other in removing the charge of the particles, a gradual decrease in conductivity, extending sometimes over several hours, is noticed, as in the case of arsenious sulphide sols. Besides the processes which have been discussed above, one has also to consider (1) the possibility of a decrease in that part of the conductivity which is contributed by the micells, on account of their flocculation —a process which may sometimes make itself felt, particularly during the coagulation of highly dialysed sols; and (2) the possibility of a desorption of electrolytes caused by the coalescence of the colloidal particles, which should result in the increase in the conductivity. It may be clearly recognised that both these processes will cause a change in the conductivity only during the course of coagulation and not before its commencement.

The mutual coagulation of colloids has also been carefully studied by us. With mixtures of ferric hydroxide and arsenious sulphide sols taken in various proportions by volume, an initial decrease in conductivity, characteristic of electrolytic coagulation, followed by a slight increase after several hours due to the chemical reaction in the arsenious sulphide particles, was observed. The initial decrease, which was gradual, was greatest in the case of sol mixtures containing a large excess of ferric oxide sol. There is a striking resemblance between the time-conductivity curves obtained during the coagulation of As_2S_3 sol by ferric chloride solution and by positive ferric hydroxide sol. This indicates that ferric ions are adsorbed on the surface of $Fe(OH)_3$ particles, and that these are responsible for the coagulation of As_2S_3 sols. It has also been observed that the $Fe(OH)_3$ particles form an envelope round the As_2S_3 particles during the process of mutual coagulation, but their union is not so strong as to appreciably alter the chemical changes taking place in the As_2S_3 particles which cause an increase in the conductivity.

The coagulation of ferric oxide sols containing positively charged particles by ferric oxide sols with negatively charged particles has also been examined, and the results indicate that the reaction between the stabilising ions plays an important part in causing a decrease in the charge of the particles and consequently their coagulation.

In all cases of mutual coagulation studied by us so far there appeared to be, in addition to the ionic reactions discussed above, a specific effect introduced by the drawing together of the oppositely charged particles, which facilitates the mutual coagulation of the sols.

A parallel study of the changes in various properties of colloidal solutions and gels during different colloidal-chemical reactions is expected to reveal the real nature of the delicate changes taking place in these systems, and a systematic investigation on these lines is being carried out in our laboratories.

K. KRISHNA MURTI.
B. S. KULKARNI.

Nagpur, C. P.
December, *1933*.

Research Notes.

Mucus Production during Plant Decomposition.

J. G. SHRIKANDE in the course of two papers (*Biochem. Journ.*, **27**, 5, pp. 1551–1574) has thrown fresh light on the problem of the production of mucus by plants during their decomposition. By an ingenious device he has measured the stickiness resulting from a variety of methods of decomposition of different kinds of straws. It is found that the degree of decomposition varies with the source of the nitrogen supplied, and the initial and final reactions of the material. In cases where the source of nitrogen is either sodium nitrate or mould tissues the stickiness is great suggesting thereby an alkaline reaction. As regards the actual mucus producing agency, Shrikande has determined that two sets of organisms are responsible,—fungi and bacteria,—and that there is a definite correlation between the two. The action of the fungi and bacteria independently does not produce any mucus and fungus decomposition followed by the action of *Mycobacterium agreste* gives the same result, while the action of *Spirochæta cytophaga* following that of fungus decomposition produces mucus. If the action of the two is simultaneous the stickiness produced is not appreciable.

Saffron Cultivation in Hyderabad (Deccan).

PROFESSOR M. SAYEED-UD-DIN of Osmania University is to be congratulated on the initial success which has attended his experiments on the cultivation of saffron (*Crocus sativus*) whose home is said to be Kashmir. Last September fresh bulbs were obtained from the Agricultural Department, Kashmir, and they were planted in pots and in specially prepared soil, consisting of fine sand, garden earth, animal and leaf manure in certain proportion. Special attention was devoted to watering. At the end of ten days, the bulbs germinated and in a couple of days after this, the first leaf put forth. It took about forty days after planting, for one of the plants in the ground to blossom and the flower was normal in colour, size and arrangement of parts. It withered after four days and its fragrance is reported to be quite as good as that of any obtained from N. India. Prof. Sayeed-ud-Din is continuing his experiments, the results of which must have a far-reaching influence on the commercial aspect of the cultivation and spread of this important plant in Deccan.

The Basal Regions of Granitic Bathyliths.

FROM a systematic study of metalliferous veins and their relation to granitic bathyliths, W. H. Emmons, in a recent paper (*Jour. Geo.*, **41**, 1933, pp. 1–12) has shown that all such metalliferous deposits are in the regions above the bathyliths and in the outer shells of the bathyliths—the core of the bathylith being wholly barren of such valuable deposits. A normal bathylith may thus be divided into (*a*) the metallised roof, (*b*) the metallised hood, and (*c*) the essentially barren core. According to Emmons "the metals were expelled from the magma that solidified to form the core after the hood had solidified; and it is believed that deposition of metalliferous veins was practically completed before the core solidified. The magma that forms the core was practically sealed off from deep-seated sources of metals before it became solid. Veins without metals are found in it, but practically no valuable metalliferous deposits."

The Strength of the Earth.

IN a recent paper on the strength of the Earth (*Jour. Geo.*, No. 7, 1933) J. S. DeLury advances various reasons for refusing to accept the hypothetical zone of weakness—the asthenosphere—below the earth's crust, as it was originally defined by Barrell. If such a weak zone should exist, which according to some is essential for the restoration of isostatic balance, the geologist would then be largely dependent upon the horizontal migration of material on the earth's surface—a cause which seems inadequate to account for the great changes of level of the crust. Further the existence of a thick yielding zone postulates equal strength in levels which have different pressures, temperatures and compositions. In view of the fact that strength is directly dependent upon these variable factors, the possibility that these are happily combined to permit a thick zone of uniform strength seems very remote.

The Mechanism of Earth Movements.

R. G. LEWIS has recently published (*Geo. Mag.*, Nov. 1933) a paper on "A search for the mechanism of Earth Movements" of which the following is a brief summary, in the author's own words: "There is reason to suppose that a rise and fall of any part of the earth's surface may be due to anticlines travelling through the crust either (*a*) at the depth at which isostatic compensation becomes effective, which may be likened to the 'surface' on which the crust 'floats' or (*b*) at a less depth in a layer which becomes molten through the action of radioactivity. In the case of (*a*) the cause would seem to be mountain-building in the crust above and the anticlines are outflows of rock-material: the rise and fall may be about equal: there is also some slight reason to suppose that an oscillation, analogous to that occurring when a buoyant object is thrown in water, with the production of a series of waves of diminishing amplitude, has occurred, but it is not yet clear whether such an oscillation is possible. In the case of (*b*) the cause of the anticlines is the collapse of a portion of the crust which squeezes out plastic material below: a small rise is followed by a long, slow fall: a rise in one region is accompanied by a fall in an adjacent region: areas may be raised into domes by collapse of surrounding areas, in which case the central area will be a seat of vulcanicity."

Early Stages in the Development of the Monkey.

W. H. LEWIS AND C. G. HARTMAN (*Contrib. Embryology*, Carnegie Inst., **24**, 187, 1933) have described the very early cleavages in the ovum of *Macacus rhesus.* They have succeeded in obtaining the 2-celled, 4-celled, 8-celled and 16-celled stages. The first of these was kept alive in the laboratory till it reached the 8-celled stage and from these observations the authors conclude that the first cleavage of the ovum occurs in about 36 hours while the 4-celled, 8-celled and 16-celled stages are reached in about 48, 72 and 96 hours respectively. The chromosomes could not be made out in any of these cases but the centrospheres were very clearly seen.

The Breeding Season of *Bufo Melanostictus*.

THIS South Asian toad, very common in India, has been the object of some morphological study by G. Alexander (*Univ. Colorado Bull.*, **33**, 195, 1933) who seems to have found that in this animal the breeding season is in the month of November and it is at this time of the year that the ovary weight is greatest. He is disposed to regard the heightened sexual activity in the months of April and March as a case of a minor sexual cycle. In India, at any rate, the principal breeding season of this toad is in the months of April and May while a minor sexual cycle may occur in November. The period of sexual activity continues, however, from March to November.

The Endoskeleton of *Labeo rohita* (Ham. buch.).

THE last number of the *Journal and Proceedings of the Asiatic Society of Bengal* contains a very valuable contribution (n.s. XXVIII, pp. 295–347, November 1933) on the Endoskeleton of *Labeo rohita* (Ham. buch.), the celebrated Indian Carp-*Rohu*, by Daya Shankar Sarbahi, a Research Scholar of the University of Lucknow. The students of zoology in India have hitherto been labouring, and in the case of certain groups of animals are still labouring, under the disadvantage of using British text-books for studying Indian types. This has been particularly so in the case of fishes which, though primitive among vertebrates, possess an amazingly diversified and complicated structure. Moreover, the skeletons of the Trout and the Cod, that are usually given in the British text-books, are so different from that of *Labeo rohita*, a type of bony fishes studied in almost all the Universities of India (The species is "not found in Madras nor on the Western coast": Day), that the need of an adequate and suitable description of the latter was being badly felt in the teaching institutions of India. In supplying this need, the Zoology Department of the University of Lucknow has done a great and everlasting service to Indian zoology and deserves the thanks of all concerned in the advancement of zoological knowledge in India.

The endoskeleton is treated under two main headings, the axial skeleton, comprising the vertebral column, the ribs, the skull and the skeleton of the median fins, and the appendicular skeleton consisting of the paired fins and their girdles. The treatment of each part is concise, lucid and well illustrated. There are as many as 26 figures

in the text; these are neat, instructive and form a special feature of the article. Every figure is fully labelled and the explanation of the lettering is given below each. Unfortunately, the lettering is not of a uniform size and in the case of certain figures, such as 9, 11, etc., it can only be read with some difficulty.

The author gives a bibliography of 26 useful references, but there are some obvious omissions here. Parker and Bhatia's *Text-Book of Zoology*, which is not mentioned, contains a figure and a short description of the skeleton of *Labeo rohita*, and Regan's article on the Classification of the Teleostean Fishes of the Order Ostariophysi (*Ann. Mag. Nat. Hist.*, Ser. 8, VIII, 1911) would have proved useful to the author. The value of osteology is being more and more realised in studying the taxonomy of fishes, and Regan's article would have helped the author in understanding the phylogenetic significance of the structural modifications in the skeleton of *Labeo rohita*. In this article the salient features of the skeletons of the various types of Cyprinoid fishes are dealt with side by side. Reference may also be made to the fact that the author does not introduce his readers to the type of fish he is dealing with, but one can hope that in the promised contribution on the soft parts of the species this omission will be made good. Further contributions by Mr. Sarbahi on the anatomy of *Labeo rohita* will be awaited with considerable interest.

S. L. H.

Composition of Human Milk.

S. T. WIDDOWS AND M. F. LOWENFELD (*Biochem. Journ.*, **27**, 5, pp. 1400–1410) have come to certain interesting conclusions regarding the fat content of human milk. From an examination of the milk of over fifty women they have concluded that the method of extraction is very important. The work of Helbitch and Deem has shown a diurnal variation in the fat content of human milk but the precise influences that determine this variation were studied by the above authors Suckling by the baby involves two actions, pressure and suction and using different artificial methods for these two actions digital extraction and the breast pump, the authors conclude that pressure brings about a rise in the fat content of milk while suction diminishes it. Further, milk that voluntarily drips from the breast has probably the least fat content. There is also a correlation between the quantity of milk in the breast and the fat content, the latter varying inversely with the former.

Tissue Transparency Methods.

M. RAHIMULLAH AND B. K. DAS have published a paper (*Journ. Osmania Univer. Coll.*, **1**, 1933) embodying their observations on certain modifications of the well-known alizarin method of making skeletal preparations. The earlier part of the process is not very different from that described in the Microtomist's *Vade Mecum*, but the authors find that whole mounts of skeletons may be made by removing the soft parts of anatomy. Their method of preserving the whole mounts in xylol instead of glycerine is not very advantageous as no material could be left for an indefinite period in xylol. The method should prove useful in all biological institutions, especially in medical colleges, for illustrating the positions of bones in the animal *in situ*. The paper is profusely illustrated with photographs of the preparations.

Encyclopædia of Chemical Reactions.

EVERY chemist will be interested in the compilation prepared by Dr. Jacobson (*Chem. Edn.*, 1933, **10**, 614) which has been planned to give complete information regarding the chemical reactions of elements—a compilation which is intended to be "a digest of the world's chemical knowledge in easily accessible form". It has also been suggested that in order to allow of periodical supplementation, the work could take the 'card index' form. The task is gigantic and cannot possibly be completed without the help and knowledge of a large number of workers who could co-operate in covering chemical literature, published in different languages. For further information on the subject the original contribution of Dr. Jacobson may be consulted.

CURRENT SCIENCE

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CONTENTS.

The Indian Science Congress.

THE Twenty-first Session of the Indian Science Congress was recently held in Bombay under the distinguished patronage of His Excellency Lord Brabourne. This is a fitting occasion for examining its activities in the past and for formulating proposals for extending, if necessary, its sphere of usefulness in the future.

The primary object of the Congress as defined by its founders is to provide opportunities of direct personal contact of scientific workers in India and probably such intercourse is the most valuable part of its function. An annual gathering of scientists at important university centres for the discussion of reports of preliminary stages of researches is bound to stimulate and widen the scope of laboratory investigations and the evening lectures on scientific topics are expected to bring the general public to realise the importance and value of scientific research. These twenty-one years the Science Congress has been steadily devoting its energies to the furtherance of these objects and it must be admitted that a great measure of success has attended its efforts. It seems to us that the time has arrived for the Congress authorities to take stock of their old achievements and formulate measures for sketching a fresh programme of work which would bring its influence to bear more intimately on the life of the people.

Recently, on account of the curtailment of allowances by the Government to their officers intending to attend the Congress meetings, the attendance of members has become so small that scientists working in the distant parts of India have been virtually deprived of the opportunities of meeting their colleagues and holding personal consultations on the work in which they are engaged. Professors employed in the aided institutions suffer from similar disadvantages owing to the stoppage of facilities hitherto granted to them. The first object of the Congress, *viz.*, human contact, which is its most important function, will be in jeopardy unless concerted efforts are made to secure the attendance of members who by their position and experience are capable of exercising a great influence at these annual gatherings. Obviously this can be effected only by the restoration of travelling allowances to the government servants and the grant of subventions to those in private

service; without such positive assistance the poorly paid members of the teaching profession must find it hard to travel long distances in spite of the railway concessions offering some relief. There can be no doubt that this is an important subject which directly affects the success of the Congress session and we would recommend its consideration at the meeting of the general assembly. We should suggest the appointment of a committee for the discussion of the matter in all its bearings and the submission of a carefully considered memorandum to the provincial governments followed up by an influential deputation to wait on His Excellency the Viceroy. The success of these endeavours will depend as much on the prestige of the personnel of the deputation as on the merits of the case to be discussed with the authorities. It is only reasonable to expect that the Government, before they make up their mind on the restoration of financial facilities, would require to be convinced that the advantage accruing to them from the attendance of their officers outweighs the expenditure of the money involved in according to them the usual grants. Moreover, as Professor M. N. Saha has pointed out in his presidential address, the Congress, which is one of the well-established public organisations in India and which through its silent labours is unconsciously directing and moulding public opinion, deserves State aid as much as any institution concerned in the moral and material advancement of the people. Few will doubt the justice of these pleas. It should be remembered that in the reformed constitution, the legislature will acquire increasing power over the expenditure of the public funds and the representatives of the people in the Councils have to be convinced that the Congress activities are directly engaged in the promotion of the health and prosperity of the country before they can be expected to provide money for their encouragement.

It seems to us that if the Congress is to occupy a permanent position in the progressive national life of India, its programme of functions should be re-examined so as to bring it into more intimate touch with, at any rate, some of its aspects. Would it not be desirable to minimise the number of conferences where subjects whose paths cross each other in many ways are at present discussed in water-tight compartments? Archæology, Education, Engineering, Social Sciences, Forestry and Economic Science and Statistics are subjects in which the Government and the people alike are deeply interested and whether they can be included in the Congress programme deserves serious consideration. We do not think that this suggestion will, in any way, prove fatal to the primary objects of the Congress, *viz.*, the creation of a scientific atmosphere in the country, stimulation of original investigation and the realisation by the people of the importance and value of scientific research. It may be remembered that almost all these subjects are included by the British Association and the Indian Science Congress is manifestly modelled on this institution. An extended programme must necessarily impose on the Congress additional responsibility which it will have to accept if it should finally evolve into a complete Indian counterpart of the British Association for the Advancement of Science. The inclusion of Agriculture and Medicine, Psychology and Anthropology as separate sections of the Congress must be an argument for taking in other applied and complemental branches of knowledge like Engineering, Forestry, Education and Archæology. Apart from the theoretical considerations of the importance of such a procedure, it will have the advantage of minimising the number of conferences which now assemble annually at different centres and so of effecting economies on the part of the Government. An enlarged Indian Science Congress with which the scientific departments of the Government are closely associated might be used as a fresh argument for the officers receiving the usual facilities for attending its sessions. The programme of the Congress would, in such a case, become people's programme and the proceedings of the reformed Congress should become the basis of the constructive policy of the economic development of the country. A static institution has no place in the changing world and it will become obsolete if it has no genius for expansion and adaptation.

The duration of the session and the number and character of public lectures delivered under the auspices of the Congress seem to us matters which equally call for revision. The time available for a satisfactory discussion of all the papers presented at sections such as Physics and Mathematics, Chemistry, Agriculture and Botany must be found inadequate. The number of papers submitted to each of these departments is

annually increasing and most of them have a far-reaching importance and a more thorough discussion than is possible at present is likely to suggest fresh fields of investigation. If the session can be prolonged for a couple of days more, there need be no undue curtailment of time either for reading or for discussing the papers and the delegates might in such a case have wider opportunities of attending all the sections to which they may have contributed papers or in which discussion of subjects in which they are interested is proceeding. The addition of sciences which we have indicated would lead to the initiation of an extremely interesting and important series of joint meetings of different sections and the inauguration of public lectures in increasing numbers. The people have somehow got a wrong idea that scientific advancement is the cause of the greater part of their unhappiness and unemployment, besides being responsible for the perpetration of atrocities in war. To our mind the general publicity part of the Congress work is just as legitimate and useful as the more formal part of the general proceedings. In view of the great service that these public lectures will render to the people, we should have no hesitation in suggesting the appointment of a committee either by the Council or the General Assembly which should assume the responsibility of drawing up a scheme of evening lectures, selecting subjects with a view to their general and regional interest and inviting the most effective and authoritative speakers. At present these public meetings are attended chiefly by the members of the Congress and the people for whose benefit they are arranged do not make the fullest use of them. This is the fault neither of the Congress nor of the people. Perhaps a careful selection of subjects and speakers might interest the public in what seems to us the most important part of the Congress proceedings.

At the Allahabad session of the Congress in 1930, Professor M. N. Saha presented his leaflet on "A Plea for an Academy of Sciences" and as the outcome of discussion, the U.P. Academy of Sciences was founded. By an interesting coincidence of circumstances he, as general president of the Congress which met at Bombay, has found occasion to discuss this topic in his presidential address. He has elaborated the functions of the Academy and has suggested the formation of a committee to investigate the scheme further and propose a constitution. The action to be taken thereon is also indicated. We await with interest the results of the discussions to be initiated by the Congress.

Presidential Address before the Bombay Session of the Indian Science Congress, 1934.

By Dr. Meghnad Saha, D.SC., F.R.S.

I

In his Presidential Address to the Indian Science Congress at Bombay, Dr. Saha takes up the story of the universe from the point where he left off in his Presidential Address to the Physics Section of the Congress of 1925. This subject, he observes, is not only very interesting but has a great cultural value since it led to the emancipation of the human mind during the middle ages. Nay, the story of the heavens is even more fundamentally significant in the history of human civilisation: it is a remarkable fact with almost every civilisation that the sages of ancient times were constrained to construct a story of creation. The need for a story of the evolution of the universe is as urgent to-day as in the dawn of civilisation, and since the time when Kant put forward his "Theory of the Heavens" which was later elaborated into the famous "Nebular Hypothesis" by Laplace, prominent scientists have attacked this fundamental problem. Sir Norman Lockyer was one of the pioneers in the modern development of the subject: he brought spectroscopy, then newly discovered by Kirchhoff, to his aid in exploring the stellar world, and found that the spectra of the stars could be divided into a number of groups, a classification later confirmed in its essentials by the work of Prof. Pickering and Miss Cannon at Harvard. An immense amount of stellar code messages in the form of spectra was collected by Lockyer and other astronomers, particularly the Harvard group. But it was only in 1920 that the ionisation theory and the theory of selective radiation pressure rendered possible an interpretation of these messages. The former theory enables us to follow the changes in spectra as the emitting atoms

are raised to higher and higher temperatures and the outer electrons of these atoms are gradually knocked off. The latter theory shows us how a stellar atmosphere can remain without collapsing because the effect of gravitation is balanced by the pressure of radiation from the inside of the star. This theory has also accounted for the observed anomalous distribution of heavy elements like Calcium, Scandium, Titanium.... in stellar atmospheres. The application of the ionisation theory to the problem of finding the physical condition obtaining in the variety of heavenly objects an astronomer comes across, has been rendered possible, now that the structure of the spectra of most elements at various stages of ionisation is known, thanks to the work chiefly of the Bohr and Sommerfeld School of Physicists. The exploration of space has also been helped forward by the discovery of the Cepheid variables. It is now known that the nearest star, *Proxima Centauri*, is at a distance of four light years, while the bright star Sirius is twice as distant. We then find the *Pleiades* at 135 light years, and near them the *Hyades*. Such clusters are called *Galactic clusters* and are found all along the *Milky Way*. Then near the rim of the Milky Way at a distance of 10,000 light years, we find the *Globular clusters* which are much richer in stars than the richest of the Galactic clusters. The whole *Galactic system*, popularly called the Milky Way, is about 10^{23} cms. in diameter and contains about 10^{10} individual stars. At a distance of more than a million light years we find another galaxy which is our nearest neighbour—the *Spiral Nebula* in *Andromeda*. There are similar Galactic systems in the constellations Coma and Virgo; the whole of these galactic systems may be said to form a Metagalaxy as Shapley calls it, with an estimated diameter of about 10^{27} cms. According to Einstein, space is finite and has a radius of about 10^{29} cms. With the 100-inch telescope at Mt. Wilson we can only reach a sixth of this distance, but a time may come when we can reach the limit of the Universe; then nothing but void will remain.

II

It can now be perceived that the problem of the evolution of the world is of very much more imposing dimensions than it was at the time of Laplace. The astro-physicist is now confronted with the questions: *(a)* How do stars come into existence and what is their life history? *(b)* How do they maintain their stock of energy? *(c)* What happens to the radiation which is being poured into space? *(d)* What is the ultimate fate of the universe? Taking the life history of a star into consideration, it is evident that the age of the human race is itself insignificant compared with the billions of years over which that history extends. But it has been possible to arrive at a knowledge of their life history because we can see stars at all stages of evolution and piece together the history of any star from our knowledge of different moments of stellar existence as exhibited by various stars. The study is, however, subject to severe limitations on account of the limited power of telescopes and spectroscopes and also because our knowledge is obtainable only through the agency of light which penetrates our atmosphere. The following probable history of a star has been put together in this way.

A mass of extremely rarefied dark matter goes on contracting owing to the mutual gravitation of its parts. A stage is reached when the interior becomes exceedingly hot and the heat gradually spreads to the surface till the temperature rises to a value at which the surface begins to emit a dull red light. The contraction goes on and the inside of the star grows still hotter. The star is now radiating and the radiation pressure is able soon to overcome the effect of gravitation. After this stage the loss of energy by radiation will be larger than the evolution of energy due to contraction and other attendant processes. The star will become cooler and cooler until it ceases to emit light and then it passes out of sight. A star will thus have the same surface temperature twice in its history—first, when the density of matter is low and surface large, and then, when it is dying down and the density is large and the surface small. The first stage is known as the *Giant* stage, while the second is called the *Dwarf* stage. The theory of a contracting mass of gas first treated by Emden and improved by Eddington by the inclusion of the effect of radiation pressure, achieved a spectacular success when Eddington and Russell's predictions regarding the size of the star Betelgeuse were confirmed by Pease and Anderson in 1921. But this theory received a check from the discovery of white dwarfs whose density is as large as 50,000, since according to the theory the density cannot exceed 5 or 6. How, of two binary stars, one can be ordinary, while the other

is a white dwarf, is one of the puzzles that remain to be solved.

The problem of the source of stellar energy is also a very complicated one. It is known, *e.g.*, that the sun radiates $6 \cdot 1 \times 10^7$ ergs per grm. of its mass every year. Chemical, gravitational and radioactive sources are entirely inadequate to provide such an enormous stream of energy. But since Einstein showed that a mass m is equivalent to an amount of energy $E = mc^2$, the possibility of explaining this production of energy as due to conversion of matter has been opened up. The conversion is envisaged as being brought about in the process of the building up of heavy nuclei from protons and electrons on the one hand, and by the combination of a proton and electron together to form a quantum of radiation on the other. The existence of cosmic radiation of extreme hardness was adduced as evidence in favour of these assumptions, but the evidence is not conclusive. The fact that the cosmic rays do not come predominantly from the direction of the Milky Way where this atom-building must be largely in progress seems on the other hand to negative the assumption.

III

The recent discoveries in Nuclear Physics have a very important bearing on the problem of stellar evolution. At the extremely high temperatures obtaining in the stars the atoms must be nearly stripped of all extra-nuclear electrons, so that interactions taking place inside the star are mostly nuclear. The recent discovery of the neutron by Chadwick and of the positron by Anderson, has cast doubts on the fundamental nature of the proton. Some regard the proton as made up of a neutron and a positron, while others, including Chadwick, consider the neutron to be made up of a proton and an electron. Dr. Saha, however, inclines to the former view; in any case the question is of far-reaching importance in Astrophysics.

What becomes of the tremendous amount of radiation poured out by all the stars into space? When the universe was thought to be infinite, says Dr. Saha, this radiation was supposed to escape into space until the world came to a Wärmetod, *i.e.*, death due to complete exhaustion of energy supply. But on Einstein's view the radiation must be supposed to cruise round and round the world; even then there is the danger that the world may separate into dead matter and radiation, or, as some would have it, the radiation may be spent in providing the work done by the universe in its ever-increasing expansion. However, the time scale demanded by the theory of the expanding universe is too rapid to be easily acceptable. This theory has also neglected two possibilities, *viz.*, the building up of matter from radiation and the formation of cosmic ray quanta by the combination of a number of smaller quanta. That a high energy quantum can get converted into a positron and an electron has been proved by Anderson and Neddermeyer, Blackett and Occhialini and by Curie and Joliot. This phenomenon has also been shown by Dr. Saha, Dr. Kothari and Mr. R. Rai to provide a simple explanation of β-ray activity. The possibility of explaining the cosmic rays as due to the combination of a number of smaller quanta is, however, problematic and speculative, but if the assumption is found to be correct, it will provide the missing link in the chain of reactions involved in the conversion of matter into energy and of energy into matter.

Regarding the question whether the world on the whole is undergoing evolution, Dr. Saha says that our knowledge about this matter is still in an unorganised state, while the theory of the expanding universe yet requires confirmation. Personally, Dr. Saha expresses himself in favour of the view that evolution is confined to individual systems like the earth or the solar system, and that when old concentrations of mass become dead new concentrations may take their place in a cyclic way. The luminous bodies are incessantly pouring out radiations into space at the expense of their mass, but probably the quanta gather up into Cosmic Rays which again break up into matter, which may gather up in the depths of space and again form into a stellar system.

IV

Coming next to the question of the relation between Science and the problems of life, Dr. Saha points out that to a scientist life is a queer thing, not subject to reason or law like inanimate objects, but swayed in its action by inexplicable impulses which Schopenhauer collectively calls "Will". The idea of helplessness which was more keenly felt by men before the era of Science is probably the origin of religion, but it is doubtful whether the older religions which were based upon an insufficient acquaintance of the Universe, of Nature

as well as of Organic Life, and are largely subjective in origin, have ever served the purpose claimed by their protagonists. In this connection one would like to know whether, on any of the myriads of heavenly bodies described above, there may be intelligent beings and whether they have been able to evolve a system of controlling life better than ours. There is no reason to think that life should be confined to our planet alone, although nobody has succeeded in establishing communication with such extra-terrestrial beings. Bishop Barnes is also of the opinion that doubtless there are many other inhabited worlds, that on some of them beings exist who are immeasurably beyond our mental level, and that communication with them will be possible some day. Dr. Saha expresses the conviction that money spent on solving some of these problems would be well invested and the action would be statesmanlike. He believes, however, that for long years to come, men on this planet will be left very much to their own unaided resources, and that the best way to ensure the future is to foster the scientific spirit, by education as well as by propaganda, and to encourage scientific enquiry into not only purely scientific subjects like physics or biology, but also into Social Sciences. For, up to the present time, the forces which have been used for controlling human passions are religious, political and social laws. These laws have, however, been arrived at from an imperfect understanding of the problems of life, of world problems, and from the exigencies of situations of an ephemeral nature. Dr. Saha here quotes from H. E. Sir Malcolm Hailey's address to the U. P. Academy of Science to show how statesmen are looking to Science to provide man with means of dominating his own passions, and to rectify the psychology of fear which seems to rule the world. According to the Professor, Science can do this if its methods are applied with greater vigour to the subjects of human interest like Civics, Politics, Economics, History, Social Eugenics and Experimental Psychology. Science shows that there is enough for all the people in the world, if only rivalry amongst nations and communities gives place to co-operative construction and if the politician's task is, at least partially, handed over to an international board of trained scientific industrialists, economists and eugenists who will think in terms of the whole world as a unit. A new educational scheme should be devised by a World's Congress of foremost thinkers like Bergson, Einstein, Bertrand Russell, Smuts, Spengler. and others, with the special objective of weeding out mediæval passions from the minds of the coming generation, and for training them to a proper grasp and sufficient appreciation of the beauty and powers of Science. The joy of life for the grown-up men will be provided not in designing means for the plunder or exploitation of our fellow-men in various ways, but in administering to their needs, and in free development and display of the finer faculties of the mind.

Sectional Addresses.

AGRICULTURE.

President: Dr. S. S. Nehru, M.A., Ph.D., I.C.S.

DR. S. S. NEHRU'S address relates to his recent work on electro-culture.

The use of electricity in agriculture comes under two main heads: (*a*) *Electrofarming*, which relates to the use of electricity in farming operations, and (*b*) *Electroculture*, which is the application of electricity to stimulate plant growth. Considerable progress has been made in the former line, but the latter, though of very great fundamental importance, is a highly complicated and even much disputed subject.

The *classical* method of high tension discharge from overhead netting is not only elaborate and costly but also leads to highly discordant results. The *Indian* method, developed by the author, is, on the other hand, cheap, efficient and consistent in its effects. The former method involves the treatment of the surrounding atmosphere while the latter is a process of direct stimulation of the soil, the seed, the root or such other part of the plant as is expected to respond to the treatment.

The seed can be treated by (*a*) subjecting it to spark or electric discharge at high potential of over 1,090 volts, (*b*) exposure to violet rays, ultra-violet rays or X-rays, or (*c*) being shown in a radio-magnetic bed which is prepared by burying iron wire-netting to a depth of 6 inches and connecting one end of it to a radio antenna. Of the different treatments, X-ray and radio-magnetic give the most satisfactory results by facilitating quick germination, rapid growth and increased yield. Ultra-violet comes a close second and high tension spark a near third.

The soil can also be energised by the trickler, an apparatus which pumps ionised air, ozone, nitrous gases, etc., under high pressure into the soil and subsoil around the seed or the roots of the growing plant. The treatment has proved highly effective, hastened germination, resistance to a variety of diseases and increased yield being obtained.

Other treatments which have proved effective are: (1) a modification of the radiomagnetic method which consists in putting the netting around the plant instead of under it, and (2) energising flowers with the aid of a pocket dynamo. In the latter case, the treatment must be very mild, for, otherwise, it may prove lethal to the flowers.

There is practically no important seed or plant which does not respond favourably to the different treatments. The spark, the trickler and the radiomagnetic can all be easily adopted by even laymen. Seed depots can easily supply treated seeds in insulated bags. The X-ray and ultra-violet ray departments of hospitals and schools should be in a position to help with the treatment of seeds.

The last part of the address is devoted to a discussion of the *pros* and *cons* of the electro-culture treatment. The author also answers a few hypothetical questions relating to the efficiency and mechanism of action of the different treatments.

Dr. Nehru's efforts deserve much praise, particularly when considering that his researches were carried out in the midst of his arduous duties as a civilian. It may, however, be useful to point out that most of his observations are of the qualitative type and require to be supported by systematic, quantitative data. We are yet ignorant of the nature of the various factors that influence the stimulation or otherwise by different forms of energy and unless the fundamentals are clearly defined, it will be exceedingly difficult to standardise a system of treatment that could be universally adopted.

MATHEMATICS AND PHYSICS.

President: Prof. S. K. Mitra, D.SC.

IN his presidential address, Prof. Mitra has attempted to present a survey of the present state of knowledge on the transmission of radio waves round the earth, starting with the fundamental work of Hertz during the last quarter of the last century. The address incorporates the results of the investigations carried out in Calcutta by Prof. Mitra and his associates during the last few years.

A brief statement of the theoretical and practical aspects of the problem is followed by an examination of the electromagnetic field at different distances from a radiating antenna, on the basis of both a flat and a curved earth. The hypothesis of an ionised layer put forward by Kennelly and Heaviside, the formulæ of Watson, van der Pol, and Eckersley based on theoretical considerations and the well-known semi-empirical formula of Austin are next considered.

In dealing with the advent of short waves, Prof. Mitra rightly ascribes the discovery of their remarkable range and other properties to the work of radio amateurs in Europe and America.

The section on the ionosphere covers developments up to date relating to the results obtained by radio methods on the constitution of the upper reaches of the earth's atmosphere. The stratification of the ionosphere into two main and two subsidiary regions, the effective heights and ionisation contents of the strata at different parts of the day and during different seasons of the year, the effect of the earth's magnetic field on the dispersive character of the ionosphere in causing a rotation of the plane of polarisation of the down-coming wave and the phenomenon of double refraction and allied questions are dealt with. The depth of penetration of a wave pulse into the F or the higher ionised region has been estimated by measuring the time difference in arrival of the two split components of the down-coming wave using the method of Breit and Tuve. In dealing with ionic density, the curve of hourly variation in Calcutta obtained experimentally is compared with that calculated after Chapman. It is pointed out that abnormal fluctuations of ionic density occur during the monsoon months.

In regard to the agencies responsible for normal and abnormal ionisation, the rôle played by the ultra-violet light and of neutral and charged particles from the sun, terrestrial thunderstorms, meteor showers, etc., are discussed. From comparison of curves of variation of ionic density from 0600 to 1400 on 21st August 1933, the day of the solar eclipse and on the preceding and successive days, it is concluded that ultra-violet radiation from the sun is the principal if not the only cause of ionisation and that the corpuscles have little or no effect.

While the above is intended as a summary of Prof. Mitra's address, it may not be irrelevant to draw attention to a few points in it. It is doubtful if the statement " It is found that with certain medium wave-lengths, the best working wave-length is about $^1/_{500}$ of the distance which separates the two stations" (page 9) has any substantial basis. Incidentally, curve I in fig. 4 is not in agreement with Prof. Mitra's conclusion.

The wave-length of Rugby (GBR) is slightly inaccurate; it is 18·75 km. and not 18·8 km.

In considering long distance transmission, no conclusive evidence exists to definitely support the assumption of transmission of long waves by multiple reflection and of short waves by the " long hop " process as shown in figs. 5 and 6.

The curve in fig. 11, illustrating the equivalent electron density with height requires explanation. Is there any evidence to indicate that the minimum electron density at a height of 80 to 100 km. can be as low as 10 per c.c.? Again, is it possible that in the other three regions, the minimum equivalent electronic content per c.c. can be of the order of 100 or less ?

In the concluding part of his address, Prof. Mitra has referred to broadcasting on less than 10 metres. It is not clear what is meant by " And since upwardly directed rays of short waves pierce the ionosphere at all angles of incidence, there is absolutely no fading." It cannot be that antennæ on these wave-lengths will be deliberately designed to radiate vertically. Further, penetration of the ionosphere by the radiated wave even at these low wave-lengths does not take place at all angles of incidence.

These technical points apart, Prof. Mitra's recommendation of district broadcast schemes on less than 10 metres may be satisfactory for cities and a few selected areas. But as a scheme applicable to the whole country, a comprehensive examination of the problem will show that it is not easily practicable.

R. E.

CHEMISTRY.

President: Dr. Horace B. Dunnicliff, M.A., SC.D., F.I.C., I.E.S.

IN dealing with a subject of the utmost importance, the rôle of chemistry in the advancement of India, Dr. H. B. Dunnicliff has introduced a very refreshing departure from the usual practice of Presidents to deliver discourses on recent developments in special branches of chemistry. The address is most opportune; it is a matter of great importance and urgency for a developing country that all chemists "should realise their responsibility to the community and appreciate, how, in a spirit of service, they can subscribe to the progress of their native land and bring to their fellowmen the benefits of systematic scientific study." In India to-day, there is a growing need for men, who, by virtue of the training they have received, can help in the improvement of the conditions and amenities of life and assume a share in the development of the country. For this purpose the younger generation must be adequately equipped. Perhaps the most pressing need to-day is to provide an efficient educational system so that it would ensure a sound training "in the discipline and fundamental truths of both theoretical and practical chemistry and involve the provision of technological institutions in every city of commercial importance in India." "Equally important is a continuance of the systematic development of all branches of agricultural chemistry and soil physics accompanied by an initiation of industries to deal with nature's products under systematic and scientific control. Other national obligations are the organisation of pharmacy, the introduction of a Foods and Drugs Act in every province, the establishment of more laboratories as for public health, provision for better sanitation and regulated sewage disposal which, properly administered, serves the dual function of improving public health and fertilising the land."

Equally important is the need for improving the pay and prospects of the practising chemist. The tendency in the technical world is to try to obtain "the services of chemists at salaries which would not attract other professional men, for example, engineers of equivalent qualifications. It is not reasonable to expect first class results from second class material and as in every other walk of life, the best men will go to those who offer the best prospects. The chemist, by the nature of his training, is a disciplined and docile worker who carries out his duties conscientiously and without fuss. I therefore invoke the sympathy of all Governments and all private employers and earnestly beg them to offer to chemists such terms of engagement and prospects as will enable them to carry out their duties free from anxiety about the necessities of life and without embarrassment concerning the suitable education of their children."

A critical examination of the case for an Indian Chemical Service suggested by Prof. J. F. Thorpe who, as long back as 1920, expressed the view that the development of chemical industries in India could only be adequately realised through the agency of an efficient Government Chemical Service having as its primary objective the encouragement of industrial research and development, reveals that the administrative and technical difficulties of the proposal are too many. General industrial research is better carried out by an individual who has an abiding interest in the discovery he makes and who, while in safe receipt of a living wage, stands to make great profits as a result of successful investigation than by a Government official who is securely employed on terms of continuous service. The only possible department in which centralisation is at all possible is in the case of appointments dealing with analytical work which have a common basis of qualifications and in the institution of a Central Bureau of records, information and advice. There would also be a distinct advantage in having a "Central Laboratory, very well equipped, which would be an All-India Bureau of Standards, and to which analytical and testing work of almost any kind could be sent and dealt with by well-qualified chemists, physicists and engineers on payment of fees. This laboratory would be served by smaller laboratories in important places, of which the scope will be limited.... The function of the subsidiary laboratories should be confined to general types of analysis to relieve the central laboratory from undue pressure and guarantee speedy disposal of routine samples."

ZOOLOGY.

President: Prof. P. R. Awati, B.A. (Cantab.), D.I.C., I.E.S.

PROF. P. R. AWATI puts forth a vigorous plea for the introduction of biological studies in our elementary and secondary schools. He rightly deprecates the unimportant position biological sciences have been assigned, in spite of their widespread educational importance. "Food production, cattle breeding, dairy farming, fruit cultivation, control of pests damaging our crops and prevention of the diseases of our cattle require a trained body of experts in the various subsciences of biology."

The application of biological knowledge to the needs of every-day life would be far more insistent than that of physical sciences but the attention given to biology is quite incompatible with the service that this science has rendered to mankind. The cytologist, the entomologist, the biochemist, the mycologist, the bacteriologist and the eugenist all meet on the common ground of biology and the contributions of every one of these have done much to lighten the burdens of life.

The amount of ignorance therefore that pervades the average mind on biological problems is immense. Some of our greatest statesmen would probably pause before they answered where their hearts lie in their body and this is mostly due to the apathy on the part of the educational authorities,—especially in India,—towards biological teaching. And again, it is in this country, more than any other, that a strict censorship, based on a certain unreasonable attitude of mind, is exercised over sex education, which, doubtless, should form an essential part of the educational equipment of every future citizen. The impartial examination of issues like marriage, inbreeding and outbreeding, the caste system and indeed of our theological concepts themselves would yield results extremely useful in unravelling many complicated tangles of our social systems.

Prof. Awati is of opinion that the future of India will largely depend on a consideration of

many of her problems from a sound biological point of view. But the truth must not be hid that public opinion and public co-operation are both necessary for any successful termination of such a venture. For this purpose, wide-spread and popular propaganda and the commemoration of great biologists that lived and did meritorious service to mankind are necessary. In the popular mind there still exists the belief that biology merely consists in the repetition of long-winded names and the dissection of numerous dead bodies. Measures must be taken to disabuse the popular mind of this mistaken notion.

Prof. Awati concludes his inspiring address with an appeal for the introduction of biological education in every grade of teaching.

B. R. S.

BOTANY.

President: Prof. R. H. Dastur, M.Sc.

PROF. R. H. DASTUR departs from the traditional practice and speaks on the mighty but enticing theme of the nature of living matter.

The subject has attracted the attention of thoughtful men from the earliest times and, although no substantial progress has been made, it has yet led to more divergent views than any other theme recorded in human history. The philosophers of the pre-evolution days devoted considerable amount of abstract thinking to the subject, and arrived at diverse metaphysical concepts which, though highly fascinating, have yet failed to explain the concrete character of the world of reality. The scientists of the later times have sought to explain the evolution of living organisms as being governed by the universal law of redistribution of matter and energy, but they also differ fundamentally in their views regarding the nature of life. As the result of the above, we now have diverse schools of thought the guiding principles of which may be designated (1) Vitalism, (2) Mechanism, and (3) Holism.

The vitalists argue that living bodies exhibit (1) a spiritual and a mental character which cannot be explained in terms of matter and energy, and (2) the capacity of producing antigens for the reproduction and differentiation of tissues and for the unceasing transformation of energy, a phenomenon which is opposed to the second law of thermodynamics. The mechanists, on the other hand, point out that various phenomena which were once regarded as being vital have since been explained in terms of physics and chemistry. Although certain aspects of life may still be inexplicable, the living cell does, as a whole, obey the more important physical and chemical laws. With further enquiry, all the phenomena associated with life should be explicable in terms of matter and energy. A compromise between the two extreme views is provided by holism which enunciates that matter and life are not distinct entities, but that they overflow into one another to form the progressive series of the great process of whole-making. This theory has found some acceptance in recent years, but it is rather difficult to see how it differs from vitalism. "To a man of science it carries no conviction: to an enquiring mind it brings no relief."

Our knowledge of the physics and the chemistry of protoplasm has lately increased considerably and while, on the one hand, we find that the ordinary physical laws cannot be applied to it, there are yet several phenomena of life which can be readily explained in terms of modern colloid chemistry. Furthermore, we have succeeded in not only isolating but also establishing the chemical nature of many of the delicate agents—the enzymes, the harmones and the vitamins—employed in the laboratory of the living organism. Recent developments in the technique of tissue culture have also enabled us to grow and to study changes in portions of the living body as distinct from the organism as a whole.

Our concept of the unit of life has lately undergone considerable change. The nucleus which controls the reactions in the cytoplasm is itself made up of the chromosomes which, in turn, are composed of the genes. The invisible protogene is thus the first manifestation of life on this earth and the most pressing problem of the day is to determine the precise nature and the manner of functioning of the gene.

Recently, evidence has been obtained to show that living cells give off characteristic radiations which induce division in other cells. The genes themselves can be induced to undergo mutation by treatment with X-radiations. In the light of these and the fact that, by the complex working of their energy, the genes can transform inorganic matter into their own substance, the phenomenon of life would appear to be one of rhythmic interplay of the energy of these radiations with its environment.

The knowledge of life must help the causes of human betterment and progress. It has got an ethical value and will raise mankind towards the highest level of perfection. It can be obtained only as the result of constant endeavour and steady endeavour on the part of those engaged on the enquiry. To this end, the science of the future shall be directed and it may even be that the science of life will give new life to all the sciences.

GEOLOGY.

President: Prof. K. K. Mathur, B.Sc. (Hons.), A.R.S.M.

IN his presidential address to the Geology Section of the Indian Science Congress, Prof. Mathur deals with some "Problems of Petrogenesis in the Deccan Trap", with special reference to the rocks intrusive into the Deccan Trap proper. These he classifies into three groups: (*a*) the 'trachytic' or acid type consisting of granophyric trachyte, rhyolite, felsite, microgranite and granophyre; (*b*) syenite, diorite, nepheline-syenite, monchiquite, and other lamprophyres which constitute the central mass of Mount Girnar; and (*c*) olivine bearing rocks consisting of olivine-gabbro, olivine dolerite, oceanite, peridotite, limburgite, etc.

The rocks of the first group occur as large and small dykes, lava flows, and laccoliths intrusive into the Deccan Trap. The peripheral hills of Girnar provide a beautiful example of a *ring dyke* of granophyre intrusive into the basaltic flows. In the hills of Utan and Dongri in the western part of Salsette, we have a large intrusive mass of micro-granite, felsite and granophyre. A laccolitic mass is illustrated by the Barda hills of Porbunder State. Among extrusive rocks may be mentioned the rhyolite flows of Pavagad hill and the two horizontal flows of acid lava beautifully

exposed in the quarries of Kharodivadi. A large number of chemical analyses of rocks of this group are now available and they show that they are invariably supersaturated with silica, and generally show the presence of primary quartz. The genesis of these rocks cannot be wholly explained on Bowen's hypothesis of crystallisation-differentiation, and it seems necessary to consider other alternative hypotheses such as the pure melting of sial 'palingenesis' and magmatic assimilation, *i.e.*, the solution of sediments by the magma.

A series of olivine-bearing rocks is developed in connection with the basalts and intruding into them; and these appear to occupy a place complementary to that of the acid series described above. It appears that these olivine-bearing associates of the Deccan Trap may have two types of origin, depending on whether they crystallised from the normal basalt or from an ultra-basic melt. A full discussion of this problem involves a consideration of the physical conditions at some depth in the interior of the earth.

Then coming to the interesting rock types composing the igneous complex of Mount Girnar, we have mainly to deal with the rocks of the central mountain which are of an intermediate character —syenites, diorites, nepheline-syenites, and monchiquites. Of these the nepheline-syenites are by far the most interesting. The origin of these nepheline-syenites is intimately connected with the syenite and diorite of this hill by the presence of a common mineral which has been distinguished under the sub-species 'Girnarite'. It is also intimately associated with the masses of lamprophyre in a manner which suggests great fluidity of the felspathoidal magma at the time of its consolidation. There is very little doubt that the dark masses of lamprophyre are largely composed of small crystals of the ferro-magnesian minerals which occur in the associated diorite and syenite, and represent segregations from these magmas. A detailed microscopic study of these rock specimens has furnished evidence in favour of assuming a discontinuous reaction relationship among the ferro-magnesian minerals of the type

$$\text{Olivine} \rightarrow \text{Brown augite} \rightarrow \text{Green augite} \left\{ \begin{array}{l} \rightarrow \text{Biotite} \\ \rightarrow \text{Girnarite.} \end{array} \right.$$

Much field and laboratory work is needed before we can arrive at a true solution of the origin of these rocks. With the diversity of types which occur in it, a study of their origin would cover the vast region of igneous petrology with all the intricacies of petrogenesis which await solution.

There is a famous saying "He knows not England, who only England knows." This may truly be said of the Deccan Trap.

MEDICAL AND VETERINARY RESEARCH.

President: Lt.-Col. S. S. Sokhey, M.A., D.SC., M.D., D.T.M. & H., I.M.S.

IN the course of his address on the relation of research to training in medical schools, Col. S. S. Sokhey deplores the lack of scientific outlook in both the teachers of medicine and the medical practitioners in the country. With the exception of the great work of the Indian Research Fund Association, medicine in India is not productive in the sense that other sciences are. This is largely due to the fact that medical schools are not turning out men with the desired scientific outlook and habits of serious application associated with trained investigators. Some teachers argue that the chief concern of medical schools is to turn out practitioners of medicine and that medical research as well as the training of research workers should be carried out in separate institutions which will be specially devoted to that work. Such an assertion only betrays the want of understanding of the scientific spirit of medicine and a tendency to treat the subject as an empiricism. The present state of affairs is highly undesirable and in view of the prospects of increased responsibility for medical education in the country, it is desirable that we should now make a critical examination of the position and model our system of training along the lines pursued in Europe and America.

Medicine has now attained the status of a science, so it would be faulty to speak of 'systems' of medicine. Pre-scientific systems are based on false doctrines, so the only valuable things that remain of them are a number of drugs which are now being investigated by scientific men. On the other hand, it is futile to waste money on Unani and Ayurvedic medical schools and hospitals which are being conducted by men who have neither scientific outlook nor scientific training. It is true that there is shortage of medical men in the country, but the best way to meet the situation is to organise mobile dispensaries and large bodies of health visitors.

The medical schools in India are still of the 'clinical' type and aim at only producing 'practical doctors'—men and women who can be trusted to recognise, by rough and ready means, the disease symptoms and carry out treatments by standard methods that they have been taught. The training given in such institutions is faulty because the students lose their critical faculty and become prey to dogmatism. This is chiefly due to the unsatisfactory system of clinical study which reduces diagnosis to the level of empiricism. The right type of training would be possible only if the students are taught to associate their clinical observations with known physiological, pathological and biochemical phenomena so that they would have a real insight into the nature of the condition that they are treating. The organization of teaching should also be improved by appointing whole-time professors who will be actively engaged in research.

The pre-clinical sciences, anatomy, physiology and pathology are now being taught by whole-time professors, but the latter receive practically no assistance in their work: nor do they have proper facilities for research. These defects should be soon attended to and the professors given the requisite technical assistance and material facilities for their researches.

The importance of post-graduate training in different branches of medicine cannot be over-emphasised. The right type of students should be selected and encouraged to conduct original work either by themselves or in association with the professors. The most promising among them should also be assisted with Fellowships to proceed abroad and work in the laboratories and clinics of distinguished men.

Col. Sokhey's address contains a few home-truths which none will deny. His condemnation of the Ayurvedic and Unani systems is, however, a little too severe. Even empirical systems which have proved consistently successful must have a scientific back-ground which the practitioners of

those systems may not be in a position to appreciate. It remains therefore for the trained scientist to approach those subjects with some spirit of modesty and endeavour to explain the treatments and related clinical observations in terms of modern medicine.

ANTHROPOLOGY.

President: Rai Bahadur Ramaprasad Chanda, B.A., F.A.S.B.

IN the Anthropology section Rai Bahadur Ramaprasad Chanda has dwelt in his presidential address on the origin and history of the spirit of renunciation and self-sacrifice, *Śramaṇism*, in the Hindu religion. From the writings of Megasthenes and other Greek travellers it is seen that the Buddhist *śramaṇists* were of two kinds, the Hylobii (*vānaprasthas*) and the *Bikshus*, *Yatis*, and *Sanyāsis*, who practised self-mortification and meditation. Suicide, as the final act of asceticism, which was in vogue at the time, had not the support of early Buddhist and Brahmanic records, though some others such as *Nirgranthas* and Jain *śramaṇas* had glorified it. In more remote days, *i.e.*, in the days of *Apastamba*, *śramaṇas* were not regarded as superior to *grihasthas*. The extracts from the earliest Dharmasūtras show that one could attain *mōksha* by performing the pious deeds of a householder, and the *śramaṇas* were not sanctioned by the Vedas. *Śramaṇism* could not have been an offshoot of a Vedic Āryan institution, but must have had its origin outside the pale of Vedic Āryanism. Among the Vedāntists, the school of Bādarāyaṇa was opposed to a non-Āryan origin of *śramaṇism*. According to the Vedānta-sūtra *mōksha* can be attained only by the knowledge of Brahman-Ātman and one need not perform the Vedic rites of a householder but may renounce *karma* and pursue the knowledge of Brahman as a *śramaṇa*. Jaimini on the contrary contends that the rites of a householder such as *agnihōtra* must not be given up in the face of the direct opposition of the Vedas. The President traces the origin of *śramaṇism* to the *yatis* of the pre-Vedic age. That they had been prominent in the days of the Indus civilisation is seen from the various postures of the figures discovered at Mohenjo-Daro. They were sorcerers and medicine men and later adopted the practice of renunciation and self-mortification as an effective means of acquiring supernatural powers. This quiet non-Āryan institution gradually overcame the old Brahmanism and became modified by it. The later *smrithis* and *purāṇas* and Manu advocated it. The rise of Śankara in eighth century A.D. gave a fillip to *śramaṇism*. Śankara organised the Brahminic order of *Daṇḍasanyāsis* which still survives. Since his days the Vedānta-sūtra of *Bādarāyaṇa* has become the basis of almost all the Brahman reformers, whether Vaiṣṇava or Śaiva. To-day *śramaṇism* or the renunciation of the worldly pleasures is held in highest veneration by the Hindus, and it is now believed that *siddhi* or *mōksha* is possible only for a *sanyāsi*. In Bengal the modern *Vaiṣṇavas*, *i.e.*, the followers of Caitanya, and the *Śāktas* give preference to *bhakti* as a means to attain *mōksha*. This peculiarity of Bengali psychology is attributed to a physical trait, brachycephaly. The change that must have happened among the Vedic Āryans in the remote past was perhaps similar to the quite recent tendency among educated Bengalis to seek initiation from *sādhus*. While *śramaṇism* has made great contributions to Indian culture and philosophy, it has liberated toxins in the social organism which have undermined its health. By dying without issue for hundreds of generations some of the best elements of the population have been eliminated, leading to the decline of the Hindus.

PSYCHOLOGY.

President: Manmatha Nath Banerji, M.SC., B.L.

THE address commences with a reference to the organisation and work of the Indian Psychoanalytical Society and the Indian Psychological Association which were inaugurated in 1922 and 1926 respectively. The former is affiliated to the International Psychoanalytical Association whose ostensible object is to popularise the basic principle of the unconscious life of the human mind and the technique of psychoanalysis as a curative agent of mental obsessions. The address proceeds to point out that ancient religious philosophies of India and her social and cultural structure were based on psychological foundations. It is maintained on the authority of ancient scriptures, that the purification of mind is the source of happiness, spiritual and secular and for the eradication of all antisocial tendencies. Then a plea is entered for the revival of the study of applied psychology for "the salvation of so vast a country as India, a hundred times more extensive work on psychology is necessary than is being done now. In India there is enough scope for hundreds of Laboratories and Institutes, not necessarily in the Universities and Colleges, but managed by outside agencies as well." The practical applications of psychological researches in the practice of medicine, in the education of the normal and abnormal child, in the selection of vocations, in the control and management of the criminal, in the ordered progress of industries and in the stability of society, must make the study superlatively important. The power to utilise the results of psychological studies for vocational guidance and selection is perhaps an important one and it may even be said to be an indispensable equipment of the teacher and not one in a hundred has the correct appreciation of this branch of knowledge of the child mind for a proper evaluation of its normal working, its potentialities and its inherited predispositions which have to be carefully watched, controlled and developed. For lack of adequate scientific training of the teacher, there is a great waste of precious human material which, if wisely handled, ought to contribute to the prosperity of the state. A medical examination of the school children is no doubt desirable, but still more important is a "thorough mental survey of the youth of the country". "It is necessary that every scholar should be given mental and scholastic tests at least twice during his career and his personality tested to detect if anything went wrong, by one thoroughly trained in experimental psychology and psychoanalysis." In America and Europe intensive efforts are made to provide vocational guidance to school children and to recruits to the army and air service in regard to their suitability for the kinds of service in these departments. Incidentally such experiments

throw side lights on the mental capabilities and physical fitness of the youth for services not contemplated by them and the record compiled by the American psychologists after examining 1·75 million young men, must be an excellent body of reference for similar work in India. Considering the heterogeneous admixture of pupils in the class rooms, drawn from all the strata of society, whose body and mind are a perfect enigma, a state of emergency has arisen which "requires that every University and school agency should frame regulations for appointing for every school and college one medical man and a psychologist trained in experimental psychology and psychoanalysts to conduct periodical examination of the physical and mental health of every boy and girl" with a view to suggest remedies for the deficients, to segregate the abnormal, to reform the criminal and to elevate the desirable. In the course of such examinations, the pyschologist should keep an eye on the vocational aptitudes of the scholars and after repeated tests, should be able to prescribe for the scholars the careers for which they have a natural bias. Such tests must be extended to the factories and mills where a large number of people of all ages and both sexes are employed and the results of experimental studies must yield valuable information in regard to the pre-disposing causes of fatigue, their removal, the introduction of others which make for increasing output and eliminating premature wear and tear of the human body and mind. The administrative authorities of large concerns and departments, including Governments, realise theoretically that a contented workman will put forth more than double the quantity of energy that a discontented worker will, but few will take the trouble to find out the causes which make so much difference between contentment and dissatisfaction. They are not entirely due to wages. More often than not they arise from maladjustment of the genius of the workman and the nature of the work in which he is employed and frequently by a slight alteration in the position the workman is capable of putting forth his maximum talents. The knowledge of adult and juvenile psychology and a disposition to create comforts by granting adequate wages would earn for the management infinitely more profit than ignorance, want of courage and niggardly policy. It may be recollected that a division of applied psychology was added to the Carnegie Institute of Technology in 1915, known as Division of Co-operative Research which conducts surveys for individual firms. In every enlightened country there are Psychological Corporation, the Personnel Research Federation and the National Research Council engaged in the investigation of industrial psychological problems and in India, except the psychological laboratories attached to the Universities, there is hardly an institute comparable with what other progressive countries possess. Each province must organise its industrial psychological station, vocational guidance institute, experimental psychological laboratories, and mental surveys of school children.

Asiatic Society of Bengal.

THE 150th Anniversary of the Foundation of the Asiatic Society of Bengal—India's Oldest Society—was celebrated on the 15th of January. A banquet was arranged on the occasion for a distinguished company. Dr. L. L. Fermor, the President, in his speech, outlined the history of the Society founded by Sir William Jones for inquiring into the history, civil and natural, the antiquities, laws, arts and sciences and literature of Asia. The Governor of Bengal paid a glowing tribute to the Society for its splendid record of work. "Giants have been associated with the activities of the Society from the beginning and more than a score of men had won for themselves a place in the world's encylopædia of scholarship."

The Bombay Society and the Ceylon Society founded in 1827 and 1845, respectively, were both inspired by the successful preliminary work of the Asiatic Society of Bengal. The administration and the publication work of the Indian Science Congress, founded in 1914, is looked after by the Asiatic Society when the Congress is not in session.

The following honorary anniversary members were elected on the occasion: His Royal Highness the Prince Damrong, Rajanubhab of Siam, Buddhist Scholar and President, National Library, Bangkok; Professor Arthur Christenson of Norway; Professor Taha Hussain; Sir John Marshall, late Director-General of Archæology; Dr. Rabindranath Tagore; Dr. Oan Kan, President, Batavia Society of Arts and Sciences, Java; Sir Sidney Burrard, late Surveyor-General of India; Professor Albert Einstein, Member of the Royal Prussian Academy of Science; Professor Hedin, Geographer, Sweden; Professor Lacroix, Secretary, Academy of Sciences, Paris; Dr. Henry Fairfield Osborne, President, American Museum of Natural History, New York; and Lord Rutherford, ex-President, Royal Society of England.

Messages of congratulation have been received from the Viceroy, the Royal Society, the British Museum, and several institutions in America and Australia.

Shellac in the Moulding Industry.

By N. Narasimha Murthy, M.Sc., A.I.I.Sc.

SHELLAC was used in India as the plastic material in the manufacture of bangles and sealing-wax. The moulding powders made with shellac are similar to sealing-wax in composition but contain a greater percentage of fillers. These moulding powders in admixture with various natural resins such as copal, dammar and bitumen, were extensively used in foreign countries for making door knobs, bottle stoppers, push buttons, terminal heads, radio-dials, etc. With the advent of gramophone industry and the increasing use of shellac in the electrical industries the price of shellac went up and cheaper synthetic substitutes came into use.

The synthetic substitutes used for making gramophone records are celluloid, cellulose acetate, cellulose xanthate and resorcinol-formaldehyde resin. The records made from these resins in contrast to the shellac solid stock records have the advantages of light weight and non-fragility. But the use of the trailing needle to overcome needle-drag, and the resiliency of the sides contribute towards distortion of sound especially at high frequencies. The impressions are not even, and in some cases they are only sub-permanent. Besides, they wear out the stampers during manufacture. Hence the substitutes have not made much headway into the field of gramophone industry; and still, nearly 50 per cent. of the output of shellac is consumed in this industry.

In the electrical industry shellac is chiefly used for bonding mica, and for making laminated tubes and boards. The synthetic substitutes used for mica is the glyptal resin, the phenol formaldehyde resin being unsuitable as it does not wet mica. Glyptal, however, is very costly when compared especially with the present price of shellac and is said to deteriorate on ageing.

The phenol-formaldehyde resin has replaced shellac to a large extent in the laminated boards and tubes industry, chiefly on account of its resistance to heat. It suffers, however, from the defect known as tracking and is not well suited for high voltage insulation for which shellac is preferred.

The phenol-formaldehyde resin is chiefly used for composite moulding of electrical objects like switch covers, bases, socket plugs, and for objects of general utility such as umbrella handles, brush backs, etc. Shellac can be used in place of bakelite for most of those objects where resistance to heat above 80°C. is not essential. The necessary mechanical strength can be imparted by using fibrous fillers such as fabric, wood flour, asbestos, etc. The heat stability can be improved by curing under high heat and pressure in the presence of accelerators just as in the case of bakelite. Improvement in the resistance to water can be brought about if shellac modified by chemical treatment is employed.

The present low price of shellac and diminished exports is a suitable opportunity for starting moulding industries in India using shellac. Research work should therefore be undertaken in collaboration with well-equipped electrical laboratories in India wherein the shellac composition could be moulded to the required shape and then subjected to tests. No foreign country can be depended upon for the continued consumption of our raw products, and only in finding a market in our own country, can a future for shellac be ensured.

Science News.

The Malpaharias and the Census of 1931.—Mr. Sasanka Sarkar, Anthropological Laboratory, Indian Museum, Calcutta, writes:—In the *Census Report of Behar and Orissa* for 1931 (p. 233), it is stated that the "Malpaharias speak a language which has been classified as a form of the western dialect of Bengali." It is true that some Malpaharias have adopted a corrupt form of Bengali as their language but in the course of my investigations among them in 1929, I found that the villages under Bugalows, Litipara and Kunjbona still retain Malto as their mother tongue. The excess of 7,560 individuals mentioned in page 245 of the same Report over the total population is without doubt due to the Malpaharias who have not given up Malto as their mother tongue. The above contention is also borne out by the statements of Mr. Tallents, who wrote the *Census Report for Behar and Orissa* in 1921. He wrote: "On the border country of Bugalows, Litipara and Kunjbona in Pakur there are people who call themselves Malpaharias but speak Malto and intermarry with Saurias."

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India in 1931–32.—This annual publication which is familiar to most of our readers includes reports of the progress achieved during the year in the field of Agriculture and Industry, Health and Education, and the various scientific surveys under the control of the Imperial Government. Thanks to the Imperial Council of Agricultural Research, a scheme of provincial research on Rice was instituted under which "all species isolated will be fully described, maintained and made available to all parts of India and Burma, selected types will be interchanged and a botanical and agricultural survey made of local rices in each province. The scheme provides for a chain of research stations with suitable sub-stations for special tracts." The Imperial Council of Agricultural Research continued to foster agricultural and veterinary research as an all-India body and subsidised research in five Universities and assisted schemes of research connected with the Sugar Industry and the locust problems besides several other schemes bearing on agriculture and live-stock. With regard to cotton the most important development of recent years was the success obtained by a type of cotton known as *Verum* 262 which has been found to be wilt-resistant and far superior in staple to existing types. The record of work on tobacco too, is

noteworthy and the fact that India occupies a pre-eminent position in the tobacco growing countries of the world, and accounts for 90 per cent. of the total quantity grown in the British Empire, will serve to show the great need for intensive research in order to produce quality tobacco suitable for international markets. Encouraging results have been obtained from experiments directed towards the introduction of exotic varieties and improving plant and methods of curing. In the field of Medical Research, the Indian Research Fund Association financed 57 enquiries connected with problems of malaria, kala-azar, leprosy, helminthological and nutritional diseases, the use of bacterio-phages in dysentery and cholera, maternal mortality, morbidity in child birth, sprue and the anæmias of pregnancy.

Although the activities of the five surveys of India—archæological, topographical, geological, botanical and zoological—were considerably restricted due to retrenchment of both funds and personnel, yet several outstanding results have emerged during the year. The final publication of the three-volume monograph "Mohenjodaro and the Indus Civilization" edited by Sir John Marshall and published by Messrs. Probsthain & Co., in a most attractive form is one of the noteworthy achievements of the year. The topographical survey extended its work of surveying high mountain regions of Nanga Parbat and Haramush. The total area surveyed during the year was approximately 59,000 sq. miles. An improved form of "Macleod Bar" was made in the workshop at Dehra Dun and has been in constant use with the duplication of presses in the photo Zinco office at Dehra Dun. The geological survey issued a highly useful geological map of India on a scale of 32 miles to the inch, and published several important memoirs bearing on the coal resources of India. The Botanical and Zoological surveys maintained their usual high standard of activities. The valuable collection of butterflies in the Indian Museum was rearranged and due to the co-ordinated efforts of the anthropological and archæological sections the identifications of human and animal remains were carried out for the Bombay Natural History Society, the Harcourt Butler Institute of Public Health, Burma, the Calcutta School of Tropical Medicine and other institutions.

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Pasteur Institute of S. India.—The annual report of the Director of the Institute for 1933, which was presented before the annual general meeting held at Madras on the 19th December points out that during the year the mortality from rabies was the lowest rate on record being only 0.38 per cent. and this is probably traceable to the introduction of Paris Fixed Virus, and higher dosages for the treatment. The report, however, says that it is too early to draw conclusions regarding the efficacy of these innovations, and the experiments have to be continued. The Institute at Coonoor prepares vaccines for the treatment of rabies and during the year made it available in 107 centres distributed throughout the Madras Presidency, the Mysore, Travancore, Cochin and Pudukotah States, and in the Nizam's Dominions. The collection and tabulation of case cards and preparation of statistical records are being continued.

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Lac Research in India.—In his annual report for the financial year 1932-33, the Special Inquiry Officer, Lac Cess Committee, draws attention to a few important achievements in Lac Research during the year, such for instance, as the indexing of technical literature bearing on lac and allied subjects, carrying out exhaustive verification trials of the tentative *American Bleaching Test* which has been claimed to be a means of standardising seedlac and gives an indication of its age and dewaxing of lacs by various solvent processes. The outstanding feature of the year was the sanctioning by the Indian Lac Cess Committee and the Government of India, of a scheme of applied research in the United Kingdom into shellac and lac products in relation to modern consuming industries. The price of shellac was remarkably low during the year and although this has helped the retention of its use in the manufacture of high class gramophone records, the future does not appear to be cheerful as the gramophone industry is a luxury trade and is liable to suffer severely due to economic depression.

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A Note on fog and haze at Poona during the cold season.—By Dr. L. A. Ramdas and Mr. S. Atmanathan.—The note summarises the results of a study of fog or haze which occurs almost daily over Poona during the cold season. The variation of intensity and thickness of the phenomenon has been studied both visually and photographically from the 120-feet tower of the Meteorological Office. The vertical distribution of temperature in the first 120 feet above ground during fog or haze based on observations taken with an Assmann Psychrometer is also discussed. The note concludes with a brief description of the effects of local winds on the distribution of haze.

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On the nature of the frequency distribution of precipitation in India during the monsoon months, June to September.—By D. Sankaranarayanan.—In this note rainfall of 68 representative Indian stations situated in the field of the monsoon current is analysed with a view to test the nature of the frequency distribution during the monsoon months, June to September. $\sqrt{\beta_1}$ and β_2 according to the Pearsonian notation, are obtained for these stations and the variations in their magnitudes traced. The departures of these constants from 0 and 3 are tested for their significance. The paper concludes with the remark that the departures are not sufficiently high to lead to the assumption of a non-normal distribution over the greater part of the plains of India.

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Himalayan Expedition Club.—With a view to carry out the exploration work of the hitherto unknown parts of the Himalayas, and encourage sportsmanlike spirit among Indians, and to produce bold adventurous and intrepid young men for ærial, marine and climbing explorations, Mr. G. D. Joshi has organised a Club called the "Indian Himalayan Exploration Club". The Club contemplates carrying out of geographical, zoological, botanical, geological and other scientific research in the unexplored tracts. The Club will arrange to send annual expeditions to Himalayas; in the Summer of 1934 an expedition to Kailash is contemplated. Membership is open to all interested persons above the age of 18 years.

A strong Committee of distinguished people representing different professions, has been formed.

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Common Indian Trees and how to know them.—An important publication from the Forest Research Institute, Dehra Dun, prepared by R. N. Parker, I.F.S., and illustrated by Ganga Singh, dealing with forty common trees most conspicuous in the plains of India excluding the moist parts of Assam and Bengal and a tract about 100 miles wide along the Sea Coast. The book which is amply illustrated has been prepared to meet the demand for a simple book on the common trees and not intended for botanists. The more common botanical terms, which will be found essential to follow the descriptions in the text, are explained in the introduction and with the help of the explanations and the illustrations, the layman not initiated into the phraseology of the botanist will be able to follow the text. The descriptions, uses, propagation and habitat of each tree are given and the book will be found to be very useful as a simple introduction to one important branch of nature study.

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Problem of Industrial Chemistry.—Under the auspices of the Pachiayappa's College Science Association, Dr. B. B. Dey delivered a lecture on the "Problem of Industrial Chemistry in India" on the 13th December. In the course of his lecture Dr. Dey said that although the main industry of a country is Agriculture, yet several other requirements of man are supplied through other industries. Large quantities of sulphuric acid are used in these industries, and India imports more than 20,000 tons annually for her requirements. The lecturer then described the difficulties that industries had to contend against in India, such for instance, as the high railway freights, Tariff protection and transport facilities. The problem of Alkali manufacture deserves consideration and where fuel is scarce it should be possible to utilise electrical energy. Moneyed classes in India have to be awakened and by thus obtaining the necessary capital, chemical industries could be improved. India had plenty of raw materials and could harness labour. If properly utilised, there is a good future for industries in the country.

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Imperial Institute of Veterinary Research, Muktesar.—The annual report of the Institute for the year ending 31st March has recently been published. The report shows that research was organised under three sections: Pathology, Serology and Protozoology. In the Serology Section Mr. Haddow devoted the major portion of his time to the work on Rinderpest. Satisfactory results have been obtained with experiments on the immunisation of calves with goat virus, and by virtue of its being cheap and easy to apply, this method will be the method of choice in those places where the animals can be treated at the optimum age. The question of concentration and fractionation of anti-rinderpest serum was intensively studied during the year, and it is hoped that in the near future it would be possible to improve a low potency serum to such an extent that discarding will be avoided, and to raise the potency of a normal serum to that which is required for the immunisation of very susceptible animals or as a curative agent. In the Section of Pathology, Capt. Datta made an intensive study of a peculiar form of a liver cirrhosis and the well-known disease as *Bursati* both of which are met with in horses. In the Section of Protozoology, Mr. S. K. Sen made a definite advance in the subject of *Theileria* infection in cattle. It seems probable that the parasite responsible for the acute cases of *Theileriasis* is a species which has not been recorded in this country. Experimental treatment of this parasite has not so far been successful.

Twenty-two papers were published by members of the staff during the year.

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Report of the Travancore Education Reforms Committee.—We have received a copy of this interesting document which we hope to be able to review at an early date. The recommendations made for the reform of State Education appear to us sufficiently important to deserve longer and carefully considered notice.

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Indian Economic Conference.—Prof. C. D. Thompson's address delivered at the Economic Conference which met at Chidambaram in the beginning of this month will be read with wide interest and we are not quite sure if all his theories and views on the ratio-exchange, currency and production and utility will be accepted without demur. Our chief interest in the address is the reference to the exact sciences. While making out a case for the position of economics among the sisterhood of exact sciences like Astronomy and Physics, the Professor is reported to have stated that "man can only wait for astronomical changes and measure them so carefully that he is able to foretell many future changes," and that "if you ask the most learned Physicist to foretell where a newspaper dropped from a window will fall, he can do little better than a man who knows nothing of Physics." "The Zoologist would be astonished if he were asked to prophesy the number of books on economics which would be eaten by white-ants next year.'' Questions put in this form will puzzle not only the scientists but the prophets of the Old Testament as well. The business of the Astronomer is not to wait for the appearance of changes or phenomena in the sky and the motions of the Heavenly bodies, but by means of mathematical calculations anticipate them and watch their appearance when it occurs. Within certain limits the meteorologist, by studying the data, is able to forecast the weather conditions. If the physicist were given all the data such as the direction and velocity of wind blowing at the time of dropping the newspaper, the initial push it receives at the time of the throw, the weight of the paper and the nature of the surrounding objects, he will, with his mathematical calculations, be able to state within reasonable limits of precision the exact position of the landing, provided other forces do not intefere during the descent of the paper. Similarly given the number of white-ants in a given locality, the power of the consumption of each one of them during the twenty-four hours and the number of leaves in the books on economics, the Zoologist may accept the question and provide an answer. But the function of science whether exact or inexact is not to prophesy, but to investigate the truth which is carefully described. The former is the province of other departments of learning.

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We acknowledge with thanks the receipt of the following:—

"Nature," Vol. 132, Nos. 3341 to 3345.
"The Chemical Age," Vol. 29, Nos. 750 to 754.
"Canadian Journal of Research," Vol. 9, No. 4.
"The Journal of Chemical Physics," Vol. 1, No. 11.
"The Biochemical Journal," Vol. 27, No. 5.
"Berichte Der Deutschen Chemischen Gessellschaft," 66 Jahrg, No. 12.
"Journal of Agricultural Research," Vol. 47, Nos. 6 to 8.
"Experiment Station Record," Vol. 69, Nos. 3 to 5.
"American Journal of Botany," Vol. 20, No. 9.
"The Journal of Nutrition," Vol. 6, No. 6.
"The Review of Scientific Instruments," Vol. 4, No. 11.
"The Mathematics Student," Vol. 1, No. 3.
"Scientific Indian," Vol. 10, No. 59.
"Indian Forester," Vol. 59, No. 12.
"Medico-Surgical Suggestions," Vol. 2, No. 11.
"Memoirs of the Indian Meteorological Department," Vol. 26, Parts 2 and 3.
"Contributions from Boyce Thompson Institute," Vol. 1, Nos. 25 to 27.
"Transactions of the Mining and Geological Institute of India," Vol. 28, Part 3.
"The Indian Journal of Agricultural Science," Vol. 3, No. 5.
"Indian Forest Records," Vol. 18, Part 10, Vol. 19, Part 11.
Report of the President of the Carnegie Institution of Washington for the year ending Oct. 31, 1932.
"The Nagpur Agricultural College Magazine," Vol. 8, No. 2.
"Physica," Vol. 1, No. 1.
"Fisheries and Marine Biological Survey of the Union of South Africa—Report," Nos. 8 to 10.
"The Indian Trade Journal," Vol. CXI, Nos. 1433 to 1436.

Reviews.

RECENT ADVANCES IN PHYSICS (Non-Atomic). By F. H. Newman, D.Sc., A.R.C.S., F.Inst.P. 51 Illustrations. (London, J. & A. Churchhill, 1932.) 15*s*.

Professor Newman's book "Recent Advances in Physics (Non-Atomic)" is a companion volume to the two volumes of Prof. Castelfranchi's "Recent Advances in Atomic Physics". The author has dealt with the subject under eight heads as follows:—The wave-like character of Matter; The general properties of Matter; Acoustics; Low Temperatures; Electromagnetic Radiations; Magnetism; and Electricity. It is true that in such an attempt as this, of dealing with recent advances in Physics, in a single volume, the choice of the topics is one of opinion. However, the author has made a truly representative selection of matter. In the chapter on Acoustics has been included, topics like Sound ranging and Architectural Acoustics, important from the viewpoint of Engineering. The subject of the propagation of Electromagnetic Waves in ionised layers of the atmosphere which is being investigated by Professor Appleton and his co-workers has also been treated. One notices the omission of the treatment of the newest phases of Physical investigation, *viz.*, Nuclear constitution, the Neutron and the Positron. Probably the book was in press before the announcement of the important discoveries in these fields. The Chapters on Electromagnetic Radiations and on Magnetism, deserve special mention for their elegant and detailed treatment. A feature of the book in contrast to Professor Castelfranchi's two volumes is that references to original papers are given in the foot-notes in addition to the bibliography at the end of each chapter. This book can be confidently recommended to Honours and Post-graduate students in Universities.

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CAUSALITY: A Law of Nature or a Maxim of the Naturalist? By L. Silberstein, Ph.D. (Macmillan & Co., Ltd., 1933.) Price 4*s*. 6*d*. net.

It has been thought by many a physicist that Determinism in natural phenomena, considered axiomatic in Science, received a severe blow in Heisenberg's famous principle of Indeterminacy enunciated in 1927. Ever since, there has been a keen contest between the upholders of the traditional view and the modern iconoclasts with the result that the Law of Causality is considered to require a restatement. Prof. Max Planck has ably upheld the deterministic view, holding that any indeterminateness in our knowledge is due to our imperfect powers, while to an ideal mind every event would be accurately determinate. He has also stressed the heuristic nature of the law of causality. The book under review is an expanded version of a lecture delivered by Dr. Silberstein in

Toronto on this burning question of the day. As the sub-title indicates, the author has laid particular emphasis on the view that the principle of causality is only a heuristic maxim and not a law of Nature. He also attributes the indeterminacy of phenomena such as radioactive disintegration to our finite knowledge. Dr. Silberstein has clothed his learning in a light garb and uses a vivacious style to bring the facts home to the layman. The notes at the end are interesting, particularly the one containing a collection of the views of various authors regarding causality. We have noticed a few peculiarities of expression and one addition to the short list of errata, *viz.*, "commeration" for "commemoration" on p. 114, line 12. The book, on the whole, represents the aspect of the newer development in Physics as it appears to one trained in an earlier school. Coming as it does from the pen of one so well known as Dr. Silberstein, it is sure to command a wide circle of readers, and we wish it the success it deserves.

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A CENTURY OF PROGRESS SERIES: (1) *Sparks from the Electrode*. By C. L. Mantell, pp. 127. (2) *Time, Space and Atoms*. By Richard T. Cox, pp. 154. (3) *Frontiers of Medicine*. By Morris Fishbein, pp. 207. (The Williams and Wilkins Company, in co-operation with 'The Century Progress Exposition,' 1933.)

These three wonderful books like the other sixteen in "A Century of Progress Series" are written by some of the most well-known authors. It may be said that these books are a landmark in book production, in as much as they aim at the layman understanding high technical matter without much difficulty and have achieved a tremendous success. The style is easy and charming. The get-up of the books is extremely nice, to say in a word. No student of contemporary knowledge can afford to go without reading them.

A Century of Progress—1833-1933—was a period of extraordinary human activity, and it was but meet that the organisers of the "Exposition" thought it worth while to publish authoritative works on the different branches of knowledge, in such a way that the lay reader can get a comprehensive view of man's achievements in the different branches of learning leading up to the various discoveries of moment, in a brief compass. It was a period in which there was an extraordinary advance in man's knowledge, for instance, of metallurgy, electricity and automobiles leading up to the construction of liners of huge tonnage in the order of tens of thousands, drudgings which go down to depths of the order of miles together, down in the deep seas and aeroplanes and balloons rising to unimaginable heights where air is rare and life is extinct, only to cite a few instances. The wondering reader cannot but more than satisfy his curiosity after reading these small books. These books which are written in easy and understandable style, may well be placed in the hands of all students including High School pupils with much profit, as it will unhesitatingly go a long way in increasing their general knowledge.

SPARKS FROM THE ELECTRODE. By C. L. Mantell.

This book which is intended to give an "interesting although cursory understanding of the part the electro-chemical industries play in the United States" in the words of the author, more than amply justifies the hope.

The book opens with a chapter on "The Wealth of Niagara" giving an account of industrial development with the help of the huge waterfalls. Like the development of power from Watt's Steam Engine, harnessing of Niagara Falls in the latter end of the nineteenth century was an important event in the history of industry; with small beginnings, the scheme has now developed to huge proportions, with power in tremendous blocks, power for the production of chemical and electric furnace products, electrical energy to operate chemical plants, and to produce many alloys, to mention only a few activities.

Then follows the description in brief, and an account of various discoveries, by men like Sir Humphrey Davy, Faraday, Volta, and others who built up the modern science of Electricity and Electrochemistry; an account of the various uses to which electricity is put in the modern day, in the kitchen, in health and beauty and in enriching nations. A special feature of the book is its beautiful charts and diagrams.

TIME, SPACE AND ATOMS. By Richard T. Cox.

The book opens with a quotation from "Eziekel" describing the measuring of things by Eziekel, and in what follows is to be found the attempts of scientists in

making various measurements, beginning from the measuring of the speed of light to that of finding out the nature of molecular and atomic structures and the application of this knowledge. And a scientific account of the present-day knowledge concerning electrons and photons, radio-activity and quantum mechanics is given.

The book is illustrated with beautiful diagrams to help understanding.

FRONTIERS OF MEDICINE. By Morris Fishbein.

A special feature of this volume is its narrative form. Starting from the very earliest periods right up to the present-day medicine, with all its intricacies involving the use of mechanical accessories, an account of the medical progress is given in a manner which makes it a delightful reading. At the end of the reading one will be left wondering how it was at all possible to know so much in such a short time. As long as humanity lasts the science of disease and its cure must last. With the growth of man's ingenuity there is a proportionate growth of his understanding of the "ills to which man is heir" and his attempts to get immune to it. An account of man's struggle in this direction and his successes in his attempts are here given. Modern medicine "does offer the living of most lives to the maximum period of expectancy and such living, with wealth and usefulness".

B. V. S.

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VOCATIONAL GUIDANCE IN ENGINEERING LINES. Elicited and Edited by the American Association of Engineers. (Published by The Mack Printing Co., Easton, Pa.)

The American Association of Engineers has done a great service to the young men in particular, by putting in their hands 'Vocational Guidance in Engineering Lines' a book dealing with the main divisions of Engineering and its various ramifications, and written by Engineers who have attained leadership through years of practice in their respective fields.

While each author has dealt with his specialised subject in a thorough and convincing manner they have all stressed the importance of Mathematics, Physics and Chemistry as a back-ground for Engineering studies. The book teems with a fund of valuable and up-to-date information in all the branches of Engineering and also contains a few mental and psychological tests by which a student should be guided in determining his aptitude for a particular vocation in life, thus eliminating a large number of misfits from crowding into the Engineering Institutions. Each author has, besides, given a true picture of the monetary prospects and compensations in his own speciality and also general principles of conduct which go a great way in building up the career and reputation of an engineering graduate.

The following lines and branches of the profession are shown to possess, at the present time, promising prospects:—

(1) Agricultural Engineering, (2) Aeronautical Engineering, (3) Automotive Engineering, (4) Chemical Engineering, (5) Electrical Engineering, (6) Foundation Engineering, (7) Mechanical Engineering, (8) Metallurgical and Mining Engineering, and (9) Ceramic Engineering. In our opinion, however, the inducing prospects of a particular branch or branches of the Profession depend much upon the political, economic and geographical conditions of a country. For instance, Agricultural Engineering and Metallurgical and Mining Engineering have a greater future in countries like America, Australia, India and Russia with their vast untapped mineral wealth and culturable lands, rather than in England, Germany and France.

The importance of clear and impressive diction in writing and speaking has been recognised by almost every writer of the chapter, as an asset in the formation of a successful career and consequently the inclusion of a few courses in English literature, public speaking and one foreign language in the Engineering Curriculum has been deemed imperative.

The chapters on 'Idealism in Engineering' and 'Engineering Ethics' bear eloquent testimony to the earnestness of the authors in keeping the traditions of the Engineering profession on an altruistic and ennobling plane rather than on a mercenary foundation.

In our opinion, 'Vocational Guidance in Engineering Lines' is not only a classical book of Engineering information at the present time but it deserves to be used by every teacher and prospective Engineering graduate as a text-book in English for the simplicity and elegance of its diction.

G. N. GOKHALE.

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SECOND YEAR COLLEGE CHEMISTRY. By William H. Chapin, 3rd Edition, Revised. Pp. 374, 1933. Price 22*s.* 6*d.* (Published by John Wiley & Sons, Inc., London. Chapman & Hall, Ltd.)

Though the title leaves one guessing as to the nature of the contents, the volume under review is an introduction to physical chemistry. As the author remarks in the introduction, the book aims at restating in a quantitative way the various physico-chemical principles referred to during the first year of college chemistry. So far as the emphasizing of the principles of physical chemistry is concerned, the author has succeeded very well. The various new conceptions have been fully elaborated and illustrated with the aid of experimental results. Every chapter is invariably followed by a large number of exercises and problems relating to the particular topic of the chapter, thus enabling the student to get the ideas clarified and the principles impressed in his mind. In addition, two hundred exercises are provided at the end of the book.

A special feature of the book is the introduction of biographical footnotes about scientists referred to in the text. The references given at the footnote are also of such a nature that a comprehensive idea of the special work in a particular field could be gathered by students who are desirous of learning more than what is given in the text. Considering that this book is intended to serve only as an introduction to physical chemistry there is no wonder that the treatment is non-mathematical and topics like photochemical reactions and the quantum theory are not dealt with. Like most American publications the get-up is very good though the price is high.

The book under review will be a very valuable reference volume for students of the B.Sc. pass courses of Indian Universities.

M. SESHAIYENGAR.

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EARTH-LORE: GEOLOGY WITHOUT JARGON. By S. J. Shand. (Thomas Murby & Co., London. 1933.) Price 5*s.* net.

In this small book of about 135 pages divided into 14 chapters, Prof. Shand has attempted to give a broad survey of geology "in a style as interesting as that of a good story-teller" and definitely divested of all "jargon". The first seven chapters of the book deal with such general aspects of geology as "The face of the Earth," "Earth sculpture," "The book of the Rocks," etc., wherein the subject-matter is more or less of an entirely non-controversial character. In the latter half of the book, on the other hand, the author takes the reader through some of the live problems in modern geology such as "What lies beneath the crust?", "The problem of Mountains", "How is the crust held up?", "Drifting continents," etc., —subjects on which, as Prof. Shand has himself pointed out, there has been a lot of theorising and speculation at all times. Even while dealing with such abstruse and intricate problems as these, the author, with his simple style which is at once catching and clear, has been able to make his book interesting and readable even to the mere layman. This is certainly not a small achievement.

There are one or two observations, however, which one would like to make regarding that portion of the book which deals with the story of the development of life on the earth. We find, for instance, a whole chapter (Chapter VI—The Creation saga) devoted to refute the ancient ideas regarding the creation of the world and the generation of life, as embodied in the Book of Genesis. This seems hardly necessary, since nobody in these days is likely to give credence to this account in the Book of Genesis—especially when we realise that all our knowledge of this is based on an "English copy of a Latin copy of a Greek copy of a Hebrew copy of an Assyrian copy of a Chaldean copy of a tale told in old Babylonia" probably before 2500 B.C.

On the other hand, one would have liked to see a full chapter devoted to "The History of the Earth" embodying the more interesting and appealing features, in all aspects, of the past history of our globe, instead of the rather dry skeleton of this given on pp 40–41. Aided by a few striking illustrations, Prof. Shand with his remarkably easy and popular style, could, no doubt, have made a chapter like this the most interesting part of his book.

On the whole, the book is a welcome publication, especially to those who would like to be familiar with the general ideas of geology and their significance.

L. R. RAO.

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SNAKE LIFE SIMPLY TOLD. By J. Morewood Dowsett. Pp. viii+108 with a coloured plate and ten illustrations. Second Edition. (John Bale, Sons and Danielsson, Ltd., Great Titchfield Street, London.) Price 5*s.* net.

Endless fancies, prejudices and superstitions concerning snakes exist in the popular mind and a book setting forth their habits, the important rôle they play in Nature and their anatomical features and their genetic relationship must be welcome. The amount of ignorance concerning these facts is almost universal and there are romantic stories about some of the well-known forms. Few will realise that snakes are polite and useful members of civil society and their fangs are not half so dreadful as the tongue of some of its members. The service of snakes in promoting the health and prosperity of man is too unostentatious to be recognised and too disinterested to be appreciated generally. The prejudice is a matter of ancient history.

There are several excellent books on the subject of snakes and this monograph will be a useful addition. It provides correct information on several questions which must naturally occur to every man who has the good luck to come across a snake in its native haunts and it seems to us that books of this description should be more widely read than sensational detective stories and love romances.

We would invite the attention of the author and the publishers to certain statements which require precise definition. For instance the term "Flying snakes" is apt to convey to the mind of the reader that these creatures are endowed with wings or an apparatus for regulating motion in mid air. Even experts on snakes may not quite grasp the force of the following statements:—

"Snakes play the game of bluff like other animals, for they belong to the Animal Kingdom" (P. VI).

"Snakes have not the wisdom ascribed to them. They belong to the Animal Kingdom" (P. V.)

There are a few grammatical and other solecisms.

"Sea Snakes are helpless on land, and have no use in their eyes" (P. 4). Again, "And birds will protect themselves by the violent use of their wings, with which they will confuse the snake, and then catch it by the neck in its powerful beak and dislocate the vertebrae" (P. 11). We are not impressed with the text figures. They seem to have been reproduced from the drawing books of the Junior Zoology class and the text figure of that noble and beautiful animal, the cobra, seems to be the handiwork of a young school girl. We hope that all these blemishes will be removed from the future edition of this really interesting work.

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ROMAN CATHOLIC METHODS OF BIRTH-CONTROL. By Marie Carmichael Stopes, D.Sc., Ph.D., Pp. xiii+221. (Peter Davies, London, 1933.) Price 8*s*. 6*d*.

Dr. Stopes is always courageous in her utterances and clear and logical in her writings. These literary qualities and the nature of the subject she deals with secure for her a very wide circle of appreciative readers. The book is undoubtedly an important contribution to the already extensive literature on birth-control and must be widely read even by those who have not taken an active interest in the doctrines of this new progressive movement, so hopeful of improving the health, happiness and prosperity of the human race.

It seems to us that the advocates of contraceptive technique and those who are opposed to it are making undue fuss in the public press and platform. The function of creative love is a fundamental fact and in Nature it is subject to the inexorable laws of elimination and preservation of the offspring. Obviously civilised man cannot go back from the artificial kingdom in which he lives. If he has to continue in this artificial world, it is manifest, he must have recourse to artificial devices for securing and maintaining his progeny in such health and comfort as his artificial environment will permit. "Birth-Control" is undoubtedly in the nature of a serious physiological and ethical experiment and it is too premature to pronounce a verdict on its results. Surely it is not going to worsen our morals. It is not likely to harm our body any more than sophisticated diet, alcohol and the thrills of modern social life. It is not likely to upset the foundations of ancient religions any more than the teachings of false scientific prophets and philosophers, nor will it put itself in opposition to the efforts of religion to purify and elevate the morals of society. It is a socio-economic movement devised to impart instruction to those who may care to profit by it, in regard to certain serious obligations and responsibilities incurred through the thoughtless exercise of certain bodily functions and the grave effects which it is bound to produce on the rest of the society. Have the opponents any constructive scheme for the amelioration of

social evils which the advocates of birth-control seek to remove by spreading their message? Religion has failed to diminish the world's stock of impurity, criminality and debasement. The teachings of birth-control have nothing to do with religion and it must be poor religion which says "multiply and be fruitful" and provides no safeguards against the birth of dangerous criminals and against recurring famines. We are confusing the issues when we connect religion and birth-control and are invoking the aid and authority of religion in opposing social phenomena which are the making of man and not of his Maker, and which can be overcome only by human devices.

Dr. Stopes has set forth in this book a number of important facts concerning the Roman Catholic position on birth-control and from the documentary evidence she has produced, it is clear that Roman Catholicism enjoins certain practices which form the foundation of the modern contraceptive technique. Those who preach "abstinence", "safe periods" and such other safeguards are talking the language of ignorance. Nature knows no more imperious impulse than sex appetite, and its course and strength are not affected by the quality of food, the teachings of religion and influence of public opinion and education. We can more hopefully endeavour to steam the raging flood of the sea by repeating the Lord's Prayer than to assuage this fundamental instinct. The reason for its uncontrolled expression is due to the fact that religion and prudery have successfully veiled all rational knowledge of certain parts of human anatomy and their legitimate function in mysticism and have treated all reference to it as blasphemy. Religion has to pay the price for its unjustifiable attitude and should not grumble if the reaction is violent. The best course for the Roman Catholics and others who are opposed to the new movement is to advise their followers who may need its assistance to practise the methods under expert guidance, without injuring their sense of modesty, prudence and virtue, and if they are conceived in the fear of God and practised as a service to humanity yet unborn, they are bound to acquire the merits of a religious act. We cannot stop the movement from taking its roots in our society and our duty is clear. Let us spiritualise it.

Viewed in this aspect, Dr. Stopes' latest book is a splendid contribution and we think, however, that before the birth-control practices are popularised, there must be a wide diffusion of correct knowledge on matters pertaining to sex anatomy and physiology so as to give the more intelligent section of the community a basis to regulate their married life with happiness to themselves, credit to the society to which they belong and honour to their spiritual preceptors.

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THE SUPERNORMAL: A Critical Introduction to Psychic Science. By G. O. Barnard, M.Sc. Pp. 252. (Rider & Co., Paternoster House, London, 1933.) Price 7*s.* 6*d.* net.

The book is a scholarly presentation of the facts of spiritualism in the light of modern scientific and philosophical investigations, and the strictly logical attitude of the book must attract a wider body of readers whom generally the extravagant representations of psychic research repel. The author examines the testimony of the spiritualistic school in a cold and critical manner, in a spirit of sympathy and with a fully equipped mind for the task and the result is the convincing theory that human personality is perceived as a transient manifestation of a more permanent and universal reality. The main thesis of the book is a reassertion of the truth of psychic phenomena which can be proved as any other scientific fact and the theory of rapport is elaborated to account for the transmission of messages from the spiritual world.

The book is divided into four parts, and the several themes which compose the whole field of psychic enquiry are examined in all their aspects and much of the chaff that the emotional enthusiasts had accumulated to the derision of the sceptics is cleared. In certain chapters like The Survival of Personality and Transcendental Consciousness, the writer takes the reader to philosophic heights where new visions open out. We confess that we started reading the book with a certain amount of prejudice and are glad to state that when we arrived at the closing chapters, we developed a feeling of respect for this branch of knowledge. What greatly impresses the reader is the frank and critical enquiry of the whole range of the subject-matter and we have genuine pleasure in according a cordial welcome to this able and useful contribution to psychic literature.

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STOKE PARK MONOGRAPHS ON MENTAL DEFICIENCY AND OTHER PROBLEMS OF THE

HUMAN BRAIN AND MIND. No. 1. THE BURDEN MEMORIAL VOLUME. By Richard J. A. Berry, M.D., F.R.C.S., F.R.S.E. Pp. xix+237. (Macmillan & Co., Ltd., St. Martin's Street, London, 1933.) Price 10*s.* 6*d.* net.

This work constitutes a worthy tribute to the memory of a great and good man, the late Reverend Harold Nelson Burden, who following the faith of his Great Master, found comfort and gratification in providing for the care and control of the mental unfortunates, by founding the Stoke Park Colony "Clinics" in the cause of which he spent his life-time, mental energies and his fortune. The book comprises seventeen contributions dealing with the various scientific and clinical aspects of original research conducted by the distinguished members of the staff working under the Director Dr. R. J. A. Berry. The clinic at Stoke Park which has achieved such a distinction as the only national institution of the type in the United Kingdom that the University of London has added it to the list of Institutions recognised for practice in connection with the Diploma in Psychological Medicine for candidates offering mental deficiency as their special branch and the University of Bristol has accorded a similar recognition by availing itself of the unrivalled clinical material for post-graduate study.

The researches of medical science have established that mental deficiency is due to the fact that relatively large areas of cerebral cortex are completely devoid of all function for the reason that the majority of cellular elements remain in an embryological, non-functioning state. These areas are non-responsive to the influence of incoming extroceptive and other stimuli. This permanent arrest, *i.e.*, the non-integration of the supra-granular cortex with the deeper functioning cellular layers of the brain, leads to feeble-mindedness, idiocy, imbecility and other forms of mental deficiency. This supra-granular layer of pyramidal cells is phylogenetically youngest, appearing first among the anthropoid apes and attaining higher development in man and if this layer were to remain in an undeveloped embryonic state, then mental deficiency becomes a case of atavism. Further it has been pointed out that the full development of this important cortical layer of nervous and the association areas, may be arrested by the presence of mesoderm mesoglial cells in the embryonic brain structure. What are the predisposing causes or conditions which produce this arrest in development and will it be within the province of science to discover the time of their appearance and eliminate them? Is any treatment in the ante-natal or neo-natal period possible for the removal of the inhibiting causes? The Mental Deficiency Act of 1913 provides amelioration but intensive and prolonged researches on cyto-architectonics are necessary for successfully combating the distress.

Another problem which has engaged the attention of the "Clinics" is criminology and the work of the members of staff confirms the prevailing view that there is a definite correlation of the cubic capacity of the brain as estimated from these diametral head measurements and intelligence and in the case of the criminals this correlation is pathological. In them the infra-granular cortex seems to be under uncontrolled action and this layer is on the primitive or animal scale, producing fierce savage instincts. If the supra-granular layer were to gain preponderance, human savagery may be transformed into efficient social service. The next phase in medical research will be devoted to the investigation into the causative factors in the failure of integration of association areas and the contributions of the biological investigations into the problems of heredity will be of inestimable value.

The book is profoundly interesting. It embodies the facts of patient researches into an important branch of human problem, and the conclusions are satisfactory. The book is indispensable to every medical student and the general practitioner who should never miss the opportunities of maintaining notes of all cases of mental deficiency in whatever form it may occur and report to the "Stoke Park Clinics". It is an irony of modern civilisation that a large section of men and women is incapable of contributing their energies in the furtherance of human cause. What a terrible drain of public revenues it is to maintain the idiots, imbeciles, the mental unfortunates and criminals and to permit them to multiply their maladies in their offspring! The problem is profoundly important not only to the medical profession from the scientific standpoint, but to the legislators and social reformers who should courageously tackle with this growing evil.

We congratulate Dr. Richard J. A. Berry, Director, Stoke Park Colony, on the production of this most stimulating work on the most vitally human problem. We hope that

no maudlin sentimentality will be permitted to interfere with the solution of it, on which the future safety, happiness and prosperity of the society depends.

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BIOLOGY IN EVERYDAY LIFE. By John R. Baker and I. B. S. Haldane. (George Allen & Unwin, Ltd., Museum Street, London, 1933.) Pp. 123, *3s. 6d.* net.

This is a charming little book based on a series of six broadcast talks on some of the fundamental problems of social and economic life of the civilised communities. The knowledge which scientific researches contribute to contemporary thought has a two-fold value. There is in the first instance extension of our understanding of the facts and phenomena of nature which has its little value for the practical affairs of man and then we have a body of knowledge built up by patient researches, capable of practical application. The book deals with some of the aspects of the utilisable knowledge which recent researches in biology have placed in the hands of scientists.

Mr. Baker has given five talks which are certainly fascinating and Prof. Haldane's talk on biology and statesmanship is simply superb. In an easy and bright style, a large mass of useful information is provided and though in certain matters such as Birth-Control and Sterilisation one may not agree with the first author, still for clearness and precision of the statement of the facts and the candour with which the bearing of the teachings of Biology on the practical problems of human society is discussed, we have nothing but praise.

Unfortunately in India, men of highly cultivated minds only know the technique of rhetoric and the subtleties of metaphysics but are in many cases ignorant of the elementary facts of science. A few are conversant with certain recondite expressions of physical sciences. But the most delightful and ennobling aspects of scientific teachings are crowded out by the dust and heat of public life. The present educational system develops only a fraction of man. The broadcast talks published in book form by Messrs. George Allen & Unwin, besides furnishing the reader with a fund of useful information, are calculated to stimulate thought and further enquiry.

This little book eminently fulfils the high purpose of the authors.

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THE SCIENCE OF PEACE. By Lord Raglan. (Methuen & Co., Ltd., 36, Essex Street, W. C. London, 1933.) Pp. x + 160. Price *3s. 6d.*

Lord Raglan is a distinguished anthropologist and his opinions on the fundamental problem of peace are entitled to great respect. We have read this brilliant book with great profit but in one or two respects we venture to differ from the author. The primitive races are alleged to be peace-loving and war is said to be unknown among the early food-gatherers. The beginnings of war are traced to the custom of offering human sacrifices among the primitive and ruder agricultural communities and the practice of head-hunting on a chieftain's death. The surviving stocks of primitive groups are peaceful and the inference 'must be' that their forbears must have been strangers to wars. We are disposed to think that if the earlier races or the food-gatherers were peaceful, they did not possess the instinct of possession or aggrandisement. "Sufficient unto the day is the gatherings thereof" must have been their rule of simple lives: if, on the other hand, they made the least attempt to gather all and leave nothing for their neighbours, we can conceive the sort of relation which would subsist between two such tribes. It seems to us that in nature as well as in the unorganised communities peace depends upon well-gratified appetites of stomach and sex and whenever there was hindrance to the satisfaction of either, fight must ensue and fight is only war writ small. Suppose a group of people are reduced to starvation or prevented from exercising their natural proclivities, they are bound to rise against their oppressors, leading to hostilities the duration and intensity of which must depend upon the resources of the parties engaged in the conflict. Suppose in a community every individual member has the means and liberty to gratify his appetites in the manner he likes best, there would apparently be no cause for conflict among them and suppose the world is so constituted, world-peace is assured. Because human nature possesses what we regard as antisocial instincts, Moses laid down the Ten Commandments and from the day this Revelation was made, individuals and nations have been trying to circumvent them and because they live in highly organised and complex societies, the conflicts have become private or public enterprises.

The trouble with our civilisation is that it is a maladjustment of head and heart. Our

emotions have not kept pace with the progress of our intellect. In the case of Veddahs of Ceylon, the Punans of Borneo, the Pygmies of the Congo Forest and the Bushmen of the Kalahari Desert, the head has not outstripped the heart and their child-like simplicity of habits will certainly change if they are civilised.

The causes of modern war among nations are still to be traced to the primitive but imperious instincts of stomach and superiority complex, which may be paraphrased into trade, economic and industrial rivalries and tariffs, over-population and covetousness of the neighbour's land and cattle, emigration laws and religious and racial intolerance. In the settlement of disputes arising from any one of these or other causes, it is important to remember that two heads and not two hearts that are involved and all agreements based on the understanding of the head must be fugitive. Intelligence always strives to establish superiority and rarely is an opportunity lost to detect errors of reasoning, faulty judgment, and unfavourable settlements in the previous transactions whose revision must produce fresh disputes. The heart humanised the savage and the head civilised him and unless humanism overtakes civilisation, the prospect of world-peace must remain a dream.

The early religions set about civilising the human mind and ennobling the human heart by such excellent teachings as "Love thy neighbour as thyself," "If thine eye offend thee, pluck it out", "Do unto others as you would be done by"; "If thou call thy brother fool thou art in danger of hell-fire" and "God is love" and all prayers conclude with "Peace and Goodwill unto all men". These doctrines appeal to the heart and when metaphysical disputes and sectarianism arose trying to establish the superiority of one set of doctrines over another, bloodshed resulted.

Lord Raglan provides excellent and most convincing arguments against the doctrines of war-mongers and we admire the resources and readiness of his replies. The fourth section of the book in which he provides a constructive and well-reasoned programme for achieving world-peace is the most important contribution. Undoubtedly the first condition of world-peace is "demilitarisation of Religion". This implies not only the restoration of religions to their original purity and simplicity, by stripping them of all controversial metaphysical accretions, but their reduction to the basic formula of universal Truth, Beauty, Love and Goodness. All talk about "Soldiers" of religion must cease and man must instinctively, like Abu Ben Adam, love his neighbour and it is same as "loving the Lord". A more spirited and straightforward utterance on the humanisation of religion we have not read.

The chapters on "Education for Peace", "The Curse of Babel" and "World Civilisation" are illuminating and those confronted with the stupendous task of reconstructing the dismembered fragments of the world structure, will find hope and encouragement provided in the chapters on "Law *versus* War". "The Government of the World" and "Peace-mindedness". The Chapter on "Women and War" concludes with a pregnant sentence: "It has been said that the last thing that man will civilise will be woman, but has he ever tried." The experiment may be tried, but the subject is sure to resent the attentions of the experimenter.

The book is a superb contribution to the solution of the teasing present-day problems. We are not likely to succeed in establishing world-peace by treaties and international conferences. Peace is an ultimate fact of human nature and environment. We would like to have more books such as the one we have before us, written clearly, precisely and with knowledge and far-sightedness.

18—34. Printed at The Bangalore Press, Bangalore City, by T. Subramania Aiyar, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., for the "Current Science" Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore.

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CONTENTS.

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The Statham Committee Report.*

THE results of the enquiry into the present education system in Travancore are published in a skilfully compiled document, many of the observations and recommendations of which have a purely local interest. However, the chapter on Secondary Education is full of substance and flavour and, holding as this subject does the key-position in the framework of educational organisation, offers certain fundamental problems of far-reaching importance, which are well worth re-examination. Admittedly there is a certain amount of legitimate dissatisfaction and a large measure of criticism about the results achieved by this department and it is only natural that neither the University authorities nor the discerning public are happy over the annual output of imperfectly prepared material from the secondary schools. Several causes have tended to produce this unsatisfactory position and it seems to us that few of them could well have been avoided. Secondary Education in India is at the present moment passing through a critical transitional phase in its development and it will probably take a long time before it can fully regain its function of contributing to the moral and material progress of the country.

The complaint against the lowering of standards in the existing high schools is a grievous charge against the teaching, the examination and the equipment. Promotions from the lower classes are alleged to be very unsatisfactory and the prescription of lower minima for the eligibility of matriculates and S.S.L.C. candidates for admission to the University courses as well as the over-crowding of classes by the pupils who have repeatedly failed at the public examinations are usually regarded as other causes which have led to a fall in standards. Another equally serious cause according to the critics of secondary education is the language difficulty, candidates having to acquire proficiency in a foreign tongue which is the medium of instruction and examination. While we admit that there is a large element of truth in all these criticisms, we do not believe that they alone are responsible for the definitely poor standard of attainment presented by the secondary school candidates.

**Report of the Travancore Education Committee*, June 1933.

We consider that the efficiency of teaching depends more on the capacity and scholarship of the teacher, the range and variety of the subjects included in the curricula, the methods and appliances employed in conveying instruction and the intelligent and industrious co-operation of the pupils, than on the rigidity of examinations and higher minima. It is true that the latter influences the former, but the curse of education in India is its dominance by examinations. Secondary Education in this country about a generation ago was comparatively free from blemishes such as are attributed to it at present and the criticisms now directed against "standards" were not heard of in those days. The causes which have led to this degeneracy which undoubtedly exists, must be sought for elsewhere.

The doctrine of democratisation of education which according to its exponents means "free education for all," is at the root of the whole trouble. They would "open wide the sluices" and permit "the water of human life to flow under the bridge of education" without considering its purity and power to fertilise. The democratic ideal of education really implies that every child must, "in proportion to his aptitude and regardless of his parents' occupation", be provided with facilities for the attainment of the fullest measure of his intellectual and moral stature, but in practice the ideal actually imposes selection of candidates so that "the unfit may not block the way of the gifted and prevent us from offering to the latter a culture worthy of them." The school is certainly a democratic institution where "children of all origins mix and elbow each other on the same benches," but, while no one need be alarmed at mixing and elbowing, it must be admitted that at least for some time to come the selective effects which are expected of education cannot be realised. The children who come from homes where they have neither the proper spirit nor culture, do not possess that predisposition for learning which the more favoured ones bring to bear on their tasks and a class which presents intellectual gradients of a nature disturbing to the uniform progress of instruction cannot hope to reach such high standards of attainment as did schools a generation ago from which these impediments were comparatively absent. It may be expected to take at least three generations of secondary education before a generation of children can arise, possessing sufficiently wide and uniform intellectual equipment to profit by instruction in a manner satisfactory to the public and the university authorities. The majority of young men attending our high schools do not now possess the advantages of a cultured home, and they therefore suffer from the handicap of a meagre intellectual heritage. The so-called backward communities have to acquire enlightenment before they can impart it to their children and no amount of impatience and criticism can accelerate this rather slow psychological process. The general awakening of the masses to the benefits of education not as a reward in itself, but as a means of absorption into the professions and public service, has introduced into the class-room intellectual inequalities of a kind unknown to the generation of teachers now disappearing, and their successors are accused of not possessing that touch of alchemy which converts pewter into gold. It is true that the class-room should not recognise social distinctions but its obvious function is to discover and emphasise intellectual differences, for "democracy more than any other form of society needs an *élite*". The criticism against the lowering of standards really arises from the habit of applying the old yard-stick of efficiency to new and entirely different conditions, there has not yet been sufficient time for the large body of the intellectually backward pupils to acquire from their parents the necessary predisposition for an academic discipline. The setback in standards is a psychological phenomenon, inevitable under the existing circumstances.

Apart from the inherent intellectual weakness of the majority of secondary school pupils, over-crowding of class rooms must militate against the attainment of even reasonable standards. The universities therefore have adopted a more stringent method of selection and some of them are even contemplating a unification of the examination system. Nevertheless, one should not forget that the reasons for this indiscriminate participation in a strictly academic type of education by the people lie very deep. The interests of the public are largely economic and it will not in the end be possible to keep young men in great numbers from utilising any educational opportunities that exist to equip themselves for an honourable living. Are all these young men competent to take learning of an academic type as their ideal in life? The difficulty of

"selection" attains its acuteness when we realise that every detail of secondary education is commonly discussed by the public from all standpoints except the right one, *viz.*, the interests of culture. Really the problem of over-crowding stands in the foreground of all educational reform and its solution,—"to leave the door of higher education no more than ajar,"—however desirable it may be, will not be acceptable to the people. It will take some time for them to be convinced that it would be far wiser for their children to be diverted into vocational schools even at the threshold of secondary education from which they can never hope to derive real profit. The prolonged course of three years' study in the high schools ought to provide abundant opportunities for measuring the candidates' capacities and chances of progress in literary learning and now more than ever a comprehensive scheme of psychological tests for discovering their capabilities and natural aptitudes should be applied in order to diminish the hotch-potch in our schools. Education is a slow process of impregnating the mind, based on careful selection of intelligence wherever it may be found, and nothing can be more hostile to its purposes than the so-called democratic theory that fine literary capacities are found "in widest commonalty spread".

The outstanding feature of secondary education in India is the rapid growth in the number of institutions and of the scholars receiving instruction in them. This increase which about a generation ago might have meant advancement of national well-being is now generally regarded as a symptom of people's helplessness. Seventy-five per cent. of the pupils who sit for the public examination at the end of three years of training are found ineligible for admission to the University courses and their literary education unfits them to join their fathers' profession. There is certainly a place and use for all these discarded pupils in the body politic and one of the purposes of secondary education ought to be to discover to these candidates the extent and direction in which they can function as efficient citizens. Education in its widest sense is a continuous process of absorbing the environment which in the secondary stage should be sufficiently diversified and illuminating for the encouragement and utilisation of all kinds of talent in the service of the State. The "wastage of pupils" so often complained of is clearly produced by the inelastic and inhospitable environment provided by the secondary system of education rather than by the examinations. Secondary education is at present attempting to achieve what would be impossible, even if it were desirable, namely, to cultivate literary interests in every one with a view to higher university courses. The problem of wastage of pupils is bound up with our ignorance of the fundamental structure and capabilities of the adolescent mind and teacher and pupil therefore encounter mutual resistance in the performance of their respective tasks. Revision of curricula constantly tending to the restriction of their range and quality, and prescription of lower minima at the examinations, are not a solution to the problem of "wastage", for they only transfer the problem of "standards" elsewhere.

There is another criticism to which the secondary system of education is exposed especially in those provinces in which the matriculation examination continues to be directed by the University. It seems to us that the latter is unjustifiably accused of exercising a baleful influence on pre-university education. Surely the admitting authorities must be conceded the elementary right of determining the standard of attainment and the range of studies in candidates seeking entrance to the University course and until some years ago, there was no impeachment of the relationship between the universities and the high schools. The increasing admission of misfits into the secondary schools for a purely literary type of education is at the root of this criticism also and the only way of removing the reproach is to provide a wider and more diversified course of instruction for such as seem unlikely to profit by academic studies.

The reform of secondary education in India is attended by difficulties which are absent in other countries. Here a candidate failing in the matriculation examination acquires a social stigma, however capable he may otherwise be and however well-qualified for earning an honourable and independent livelihood. Because the government have placed a premium on university degrees as a qualifying test for admission to administrative posts which are supposed to carry with them social prestige and political power, communities hitherto apathetic to higher education, have discovered, under the stimulus of "Communal representation in the Services", a passion for the rewards which a literary education is expected to

confer. This age-long apathy must necessarily impose a handicap on securing immediate academic distinctions on at least a majority of those who but for communalism, would have been content to carry on and enrich the traditional pursuits of their fathers. We must seek and foster intelligence and scholarship wherever they may be found, but no efforts of education can create them where they do not exist and the money and energy devoted to producing them might more profitably be utilised in training the young men to professions for which they possess specific aptitudes. Perhaps the most serious difficulty confronting any rational reform of education is that within recent years it has come too much within the range of communal suspicions, which can only disappear after government withdraws recognition now accorded to University degrees.

We shall have to wait for administrative reforms to be introduced by the new constitution before we can formulate any schemes for reconstructing the system of secondary education and any proposals for educational reform that may be put forward even when the reconstructed government has been introduced must be of a tentative character, for India is an organism still in the process of becoming. A certain measure of national stability in the wider sphere of its functions is indispensable for the sound evolution of educational reforms the necessity for which will need to be adequately understood by the new legislature. Only a thorough conviction that a sound secondary education with a wide range of selective courses must form the backbone of the national well-being can bring effective means for overhauling the educational machinery slowly, wisely and efficiently.

The Earthquake in North India.

WE associate ourselves with the numerous agencies which have appealed for assistance to relieve the sufferings of our fellow-men in the earthquake-stricken districts of Bihar and Nepal.

The results of the scientific investigations initiated by Dr. L. L. Fermor will, we have no doubt, extend our knowledge of the geological conditions of the Sub-Himalayan regions and perhaps may even provide the people with the means of forecasting these baleful phenomena with some measure of certainty. In these regions which are obviously in the zone of weakness and strain, implied by the severe crumpling of the rock beds in the elevation of the Himalayas, within very recent times, and where the rocks have, therefore, not yet attained stability or quiescence, subcrustal dislocations must be frequent, resulting in more or less disastrous earthquakes always attended by appalling destruction of life and property. The fertility of the Indo-Gangetic alluvial plain has at all times attracted large masses of population who have built in this geologically unstable region, some of the richest cities in the East, little dreaming that their opulence and magnificence practically rest on a powder magazine within a few miles of their foundations.

The recent earthquake is far more intense than the tremors which occurred in 1833 in the same area and is nearly as ruinous as the one which overwhelmed Assam on June 12th, 1897. Earthquakes, floods, famines and cyclones have become numerous and frequent within recent years and the restoration of flourishing and populous cities which are rendered defunct by these catastrophies must be beyond the resources of a single nation. It occurs to us that the League of Nations should devise proposals for setting up an international organisation with the financial support of all countries of the world, to supplement the efforts of private philanthropy in dealing with the cataclysms over which man has no control and against which he has no means of providing protection. We do not believe that our proposal is impracticable for, in our judgment the moral significance of our civilisation must fail if it does not promote an increasing recognition of brotherhood among nations both in times of distress and prosperity, irrespective of their geographical situation and other differences. The League of Nations from its exalted position in the international life is competent to formulate and design schemes for fostering the unity of the different races now divided by narrow parochial interests and no misfortune should occur to any one of them without evoking spontaneous sympathy in the hearts of others. We can conceive of no cause or religion more sacred to humanity than provision of relief for the destitute and suffering and an earthquake is certainly that touch of Nature which ought to make the whole world kin.

The Secondary Structure in Crystals.

By S. Ramachandra Rao,
Annamalai University.

IT has been increasingly recognised in recent years that the simple lattice theory of crystals is not enough to account for the various physical properties of the crystalline state of matter. The existence of a sharp melting point, the accurate lining up of crystalline planes over macroscopic distances, the enormous influence in the physical (particularly magnetic) properties due to the absorption of foreign atoms and the volume effects of crystal grains of macroscopic sizes—these have been advanced by Zwicky as properties which need a revision of the simple lattice theory. To these we may add the regularity of a disperse system of foreign atoms in a crystal as revealed by X-ray spectra, the difficulties of a satisfactory explanation of ferromagnetism on the atomic basis, the existence of anomalous diamagnetism in some crystals as those of bismuth and graphite and the little-understood properties of elasticity (particularly fatigue, after-effect and elastic limit).

The simple lattice theory involves an accurate spacing up of like or unlike atoms in different directions, the interaction between neighbouring atoms being electrostatic or electron linked. It should be mentioned here that while a secondary (as distinguished from the primary or simple lattice) structure seems to be necessary for a proper understanding of several well-known properties, a simple physical picture of such a structure has not yet been conclusively developed.

Zwicky postulates a microcrystal block in a crystal as a region surrounded by a surface physically different from a similar surface taken within the block. This would suggest that the interatomic distance is smaller nearer the surface than inside the block. Zwicky estimates, for example, that the surface of such a block in rocksalt crystal contains 10% more atoms per unit area than in the inter-lattice planes. If such a microscopic structure is identical with the spontaneously magnetised blocks of Heisenberg in his theory of ferromagnetism, it would follow that the surface of these blocks would not merely correspond to the regions of largest crowding of the atoms but also those across which the electrons are not ferromagnetically coupled with each other.

Zwicky's calculations, based on the small differences observed between the X-ray wavelengths obtained by crystal and grating methods, lead him to a value of nearly 100 A.U. for the linear dimension of the rocksalt block. This would suggest that a block contains nearly 43,000 atoms. Bitter's results based on ferromagnetic data give a value of nearly 10^5 atoms in a microcrystal. These results also indicate that the dimension of the block is of the order of 100 A.U.

It may be pointed out that the secondary structure should give rise to a secondary spectrum in the Bragg reflections; however, since for every 30 planes in the above case we have a secondary surface, the grating obtained is very inefficient. However, Johnson reflected H atoms from a crystal of LiFl and obtained a secondary spectrum which indicated the lattice constant to have a value somewhere between 50 and 100 A.U. It is interesting to mention here the investigations of Jaegar and Zanstra on the crystal structure of rubidium. They found the co-existence of two phases, one phase being present in the other in the form of small blocks containing 36,000 atoms; this leads to a value of nearly 100 A.U. for the secondary lattice constant. It is significant that four different methods have all suggested the same order of value for the dimension of the microcrystal.

We shall now consider some special directions in which the experimental observations fully conform to Zwicky's theory and in fact would not have any other rational explanation except on this basis. First we shall take up the question of the solution of one metal in another. G. L. Clark gives an excellent account of our present knowledge of this subject in his book on *Applied X-rays*. Three cases can be broadly distinguished. In the first case, the atoms of the foreign body B replace or crowd into the lattice atoms of the given metal A. Such a crowding produces a shift in the lines of the X-ray spectra indicating smaller lattice constants. The second case arises when there are both types of microcrystals in the alloy; the characteristic spacings of both the lattices being present in the X-ray

spectra. The third case arises when chemical combinations take place involving predominantly combinations of covalent atoms; these give rise to new spacings of the lattice as revealed by X-ray spectra. It is difficult to understand these distinctions on any satisfactory basis on the simple lattice theory but once we grant the theory of secondary structure, the whole picture becomes intelligible. In the type 2, both sets of microcrystals are co-existent in the alloy in large groups while in the first case the foreign atoms are able to permeate through the microcrystal surfaces into the blocks. The relative quantities of the two constituents settle the nature of the structure of the alloy. At present there is no satisfactory basis for the energy calculations in such cases but there is little doubt that the nature of the permeation of the foreign atoms in the given crystal is fixed by energy considerations. A development along these lines is necessary if the theory of secondary structure is to be placed on a satisfactory quantitative basis.

It is interesting to note that the strongly ferromagnetic iron and the strongly diamagnetic bismuth do not dissolve in each other. This result is significant from the point of view of secondary structure since it seems possible that the consolidating tendencies of the microcrystals of these metals are too strong for the disruption of the individual microcrystals.

Another important observation that needs special notice is that when small quantities of a foreign metal are alloyed with the given metal, the lattice constant does not alter while there is a large alteration in the magnetic susceptibility. On the simple lattice theory it is doubtful whether a reasonable explanation can be given for this observation. On the theory of the secondary structure in crystals, this would mean that the foreign atoms place themselves on the microcrystal borders and while influencing greatly the magnetic properties so largely dependent on the large electron orbits on the microcrystalline surfaces, do not affect the lattice constant predominantly settled by the interior atoms.

That the foreign atoms stay in the microcrystal borders is beautifully verified by the lower melting point in general of the alloys; since the disruptive tendency between the microcrystals amplified by the presence of the foreign atoms, is mainly responsible for melting. These microcrystals, with their borders very fuzzy and their internal structure rendered less stable, account for the persistence of a crude crystal structure in liquids just after melting. As the liquids are heated this structure is broken rapidly.

The writer has recently investigated the magnetic properties of colloidal powders of strongly diamagnetic and ferromagnetic metals. As a result of these observations and the recent investigations of Goetz, there is abundant evidence to show that when the colloidal powders approach small diameters of the order of 1μ, large changes take place in their magnetic properties. The X-ray spectra of such colloidal powders appear to pass over from those corresponding to crystal powders to those of liquids, at smaller diameters. In certain experiments conducted by the writer some three years ago on the conductivity of compressed colloidal powders of Ceylon graphite the specific conductivity of particles having diameters less than about 1 to 2μ, was larger than of those having larger diameters. The investigations were not pursued at the time since the explanation of such an observation remained obscure. It now appears, however, that such an effect may be genuine and may be accounted for by proportionately greater surface conductivity. Thus the particles having diameters greater than about $1{\cdot}5\mu$ differ in properties from those having smaller diameters. The writer has shown recently that this may be due to the destruction of a large number of microcrystals on the surface of the macrocrystals.

It is significant that Goetz, to whom we owe a large amount of useful and pioneer work on magnetism and crystal structure, has found that the crystal planes line up regularly over macroscopic distances. A similar secondary structure has been observed by Bitter in magnetised crystals of nickel and iron.

In the theory of ferromagnetism, the secondary structure in crystals plays a predominant part. It is well known that Heisenberg's theory of ferromagnetism postulates the existence of a large number of microcrystals in a crystal. The resultant spins in these microcrystals have random orientations and compensate each other in the absence of an external field. The large amount of work accomplished by various investigators on thin films and the recent work on nickel colloids by Montgomery and

the writer point to the correctness of the assumption of microcrystals in ordinary crystals.

Based on these, Bitter has given a theory of ferromagnetism by which he has accounted for the properties of hysteresis and the Curie points in ferromagnetic bodies.

There is one other direction in which theoretical work should be of great significance in the proper understanding of these problems. Tartakowsky and Kudrjawzewa found that the total secondary electron emission from heated nickel decreases suddenly at the temperature corresponding to the Curie point of this metal. Hayakawa has used this method to study transformations from one state to another in metals. The structure electrons of Richardson should be responsible not only for secondary emission but also for conserving the total spin in a microcrystal so necessary for Heisenberg's theory. If these conclusions are true, it would follow that the regions of the secondary structure around the microcrystals are filled with electron energy levels having a maximum energy of at least 400 volts, and that in this manner the structure electrons are responsible for the Zwicky blocks.

It should be mentioned here that the theory of secondary structure is not without its limitations. Smekal claims that the results obtained with shearing stresses in crystals, particularly in rocksalt, definitely indicate the existence of only an ideal lattice. While therefore the problem of the Zwicky structure in crystals like rocksalt may be an open question, there seems to be, from what we have explained in this article, very little doubt regarding the existence of such a structure in metallic crystals.

Acknowledgment.

WE have pleasure in expressing our deep sense of gratefulness to the Council of the Indian Science Congress for offering "CURRENT SCIENCE" a grant of Rs. 250 for the present year. We need hardly mention that this infant venture requires all the support which it can receive from all the institutions and individuals devoted to the advancement of scientific research in India.

The Incidence of Silicosis in Kolar Gold Fields, Mysore.

By C. Krishnaswami Rao, B.A., M.B., C.M., M.R.C.P., M.R.C.S.

IT was the impression till recently that there were no cases of silicosis among the miners of Kolar Gold Fields. In the report of "The Miners' Phthisis Conference, South Africa" it is mentioned that no case of silicosis has been reported from K.G.F. While silicosis was so common in other gold mining areas, such as South Africa, that no case had been reported from K.G.F. was really surprising. It was suggested that an investigation may be started to find out the existence or not of silicosis in K.G.F. A committee was formed in 1931 to collect material and to study the peculiar conditions existing in this mining area.

Clinical histories of about one hundred labourers working underground were collected. Seventy-five chest radiograms were taken. As a control, radiograms of twenty people unconnected with underground work were also taken. Three lung specimens removed, Post Mortem of labourers who died of respiratory diseases were made available for study. Sections were prepared and examined by Pathologists.

After a careful study of this material it was concluded that cases of silicosis do exist in K.G.F. Only, it takes ten to fifteen years of underground work to develop signs of silicosis. It is due to the fact that the quartz reef in K.G.F. contains only 8 to 17% of free silica as compared to the high percentage, namely, 80 to 90 in the South African rock. The collected material was sent to "The Bureau of Medical Research, South Africa," for expert opinion.

Dr. L. G. Irvine and Dr. S. W. Simson were kind enough to give their opinion after studying the material sent to them. Dr. Irvine reports "The Pathological and Radiographic evidence appears to create a *prima facie* case that instances of Silicosis do occur amongst underground workers in the Kolar Gold Mines." He also adds that the material forwarded was inspected by Dr. A. Mavogordato who concurs in the

general conclusions stated in the report. So it can be now affirmed that Silicosis does exist in Kolar Gold Fields, Mysore.

In the *Journal of Hygiene*, August 1933, William R. Jones states that the gold-bearing quartz rock of the Kolar Gold Fields contains more quartz than the South African rock and yet produces dust that has caused no case of silicosis. There is a note on this article in *Nature*, December 16th, 1933, alluding to the point that there is no silicosis in K.G.F.

In view of what has been said, the statement contained in the paper written by W. R. Jones is not quite correct. The incidence of Silicosis may not be so great as in South Africa but there is no doubt that Silicosis does exist among the underground labourers in K.G.F. W. R. Jones is of opinion that if the rock contains fibrous minerals such as serisite they hasten the process so very considerably that their presence in the exploited rocks and materials is of far greater importance in causing the disease than in the presence of quartz. Again it is stated that such acicular fibres are absent from the Kolar Quartz rock or very rare. Therefore he infers that there is no Silicosis in K.G.F. It is certainly a very interesting observation that has been made by W. R. Jones and it will be taken into consideration in the further investigation that may be carried out in K.G.F.

The object of my writing this article is merely to point out that Silicosis does exist in K.G.F., though not so common as in South Africa.

Letters to the Editor.

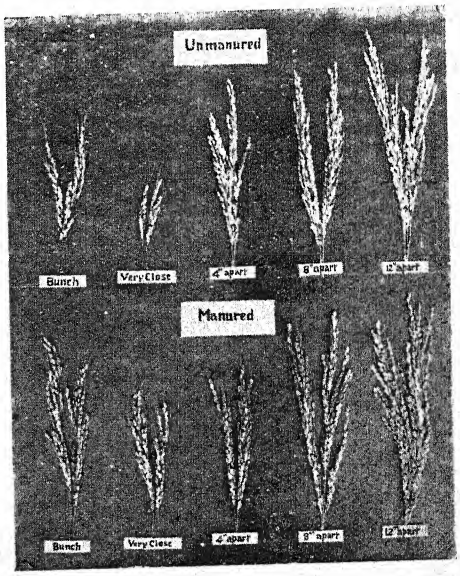
Effect of Environment on Awning in Rice.

IN 1925, when the writer was in charge of this Research Station, he observed, for the first time, the effect that overcrowding the plants in the field has on awning in rice. It came about this way. In that year, AEB. 108, a pure line type of Gandasala, a variety poor in tillering, was grown as a small bulk crop under two different spacings of 3″×3″ and 12″×12″ to see the relative yields when closely and widely planted.

According to conventional spacings given year after year to all the type collections on this Station, AEB. 108 also used to be spaced 6″ in the line and 12″ between lines. Under such spacing, this type was uniformly noted to be giving awns of the description "short tip" for the last 9 years that it was under study as a type. The awn lengths in these plants invariably were under 10 mm. and the percentage of awned grains never reached 10 per cent. of the total number of grains on an ear, on the average.

On an examination of the crop grown as a bulk, it was found that the plants in the 3″ spacing produced ear-heads with longer awns and with more awned grains than those in the 12″ spacing. The awn lengths in the 3″ spacing reached a maximum of 25 mm. whereas those in the 12″ spacing were under 10 mm. in all cases. The number of awned grains was also fewer in the latter case.

Conclusive evidence that over-crowding was responsible for the production of longer awns and more awned grains in this type was luckily forthcoming at the same time. This was from a bundle of reserve seedlings kept near the label stakes of the planted



Photograph showing the effect of spacing and manuring on Awning in Rice.

crop for filling possible gaps in it, if need be, later on. This bundle containing more than 200 seedlings was squeezed into a hole of about 4 inches square to serve as a reserve. On an examination of the puny ears formed by the emaciated plants in this

bunch, the astonishing fact was revealed that more than 90 per cent. of the grains on the ears were awned and most of the awns were between 40 and 48 mm. in length. A worse case of over-crowding could not have been imagined. An examination of all other awned varieties then growing on the station and bundles of reserve seedlings kept near each, showed that over-crowding had more or less similar effect, on awning, as noted in AEB. 108.

The cause for this phenomenon of increase in awning was at the time supposed by the writer to have been due to a deficiency of plant food and the resulting partial starvation of the over-crowded plants. This belief was strengthened by the fact that very late heads produced during the waning vigour of a plant also produced more, and longer awns.

During the last three seasons since 1931, experiments were entrusted to Mr. V. Krishnaswami, an Assistant of this Station, and he has collected a very large number of ear-heads from the various treatments for measurements of awn lengths and count of awned grains in each.

The object of the experiment, in short, was to test the effect of spacing as well as manuring on "Awning in Rice". The results indicate that the original hypothesis that lack of plant food might be the cause for increase of awns in over-crowding is not tenable, as manuring not only did not suppress awning but actually tended to increase it, though to a far less extent than different spacings did. The accompanying photograph showing typical ears of AEB. 108 taken from different treatments makes it clear to what extent different spacings and manuring affect awning in rice. The term "bunch" in the photograph stands for planting a bundle of over 300 seedlings, as such, in about an area of 4 inches square and the term "very close" for planting a similar number of seedlings in a square foot, the seedlings, in this case, touching almost one another. The other terms are self-explanatory. The manured plot received at the rate of 400 lbs. of ammonium sulphate and 200 lbs. of superphosphate per acre while the unmanured plot had not any of these.

The results of the experiments clearly show to what extent an inherited character of an organism can be modified by its environment. At the same time, the failure of awnless types included in this experiment, to produce even a remote suggestion of awns despite the maximum overcrowding and the liberal dose of manuring given, goes to prove the other fact that in the absence of a heritable factor or factors for a particular character in an organism environments, howsoever modified, cannot bring such character into being.

As the original hypothesis of partial starvation as the cause of greater awn development in over-crowded plants is no longer tenable, the writer is led to doubt whether a struggle for light among the overcrowded plants is not the cause for this phenomenon.

This hypothesis is being tested now.

M. ANANDAN.

Agricultural Research Station,
Aduturai,
December 9, 1933.

Partial Sterility in the First Generation Plants of Crosses between Wide Varieties of the Common Egg Plant (*Solanum melongina*).

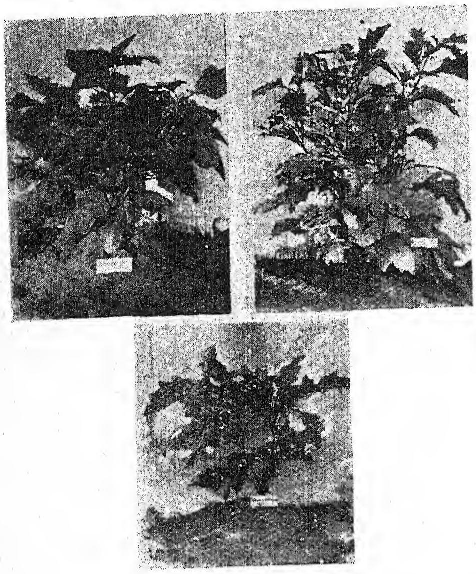
FOR the last two seasons vegetables, such as brinjals, chillies and tomatoes, are being raised on this station. Among the different kinds of brinjals grown, there was a variety got from Mysore which was strikingly different from the rest in various characters including its general look. It had greater resemblance to a datura plant than to ordinary brinjal in its appearance. So using Mysore variety as the common male parent in all, crosses were carried out with four different kinds of ordinary brinjal plants as shown below.—

1. White round ♀ × Mysore brinjal ♂
2. Long mottled ♀ × Mysore brinjal ♂
3. Long purple ♀ × Mysore brinjal ♂
4. Big round ♀ × Mysore brinjal ♂

The first generation plants show considerable vegetative vigour and in general appearance resemble more the Mysore parent and so these are undoubtedly crosses. The chief distinguishing characteristics of the parents and the F_1 would be clear from the photograph (*vide* Plate I).

The most interesting feature of the F_1 generation plants is the partial sterility shown by them. One sowing of the F_1's with their parents was done on 15-5-1933 and a second one on 29-8-1933, to eliminate any possible seasonal effects. In both the groups of sowing, the number of flowers

produced by the F_1 is 5 to 6 times more than either of the parents and yet fruiting has practically been nil in the F_1's. The parents which began to flower by the end of July and end of October have exhausted themselves by producing good many fruits, while the F_1 plants have shown no indication of developing any healthy fruit though they flowered as early as 1st August in the first sowing and 2nd November in the second sowing. Only recently one or two very small globe-like fruits of the size of a



Upper Figure: Left—Ordinary Brinjal (Female) Parent, *Right*—F_1 and *Lower Figure:* Mysore Brinjal (Male).

big gooseberry are seen in the early group of the F_1's. It is too early to say whether they would develop into normal fruits and contain viable seeds.

On examination of the anthers of the first generation plants, it is found that more than 90 to 95 per cent. of the pollen grains are ill-developed and devoid of contents, while the parental plants grown along with the F_1's show abundance of healthy pollen in their anthers. This perhaps accounts for the poor setting of fruits by the F_1 plants. Probably this is another example of partial sterility resulting from wide crosses as noted in other species of plants, and the cause for the abortive pollen has to be sought for in the breakdown or degeneration of the chromosomes at the reduction division as noted in other hybrid plants. Cytological examination of the pollen may prove this to be the fact. Back crossing with the parents is also being attempted to find out if the ovules in the F_1 are fertile.

T. K. BALAJI RAO.

Agricultural Research Station,
Aduturai,
December 12, 1933.

A Note on the Regularities in the Spectrum Ce III.

THE writer has for some time past been studying the regularities in the Spectrum of doubly ionised Cerium. Recently Kalia[1] has given in detail the regularities in the above spectrum. A number of terms originating from the main electronic configurations have been found by him but the J values of many of the terms have not yet been fixed. It is evident, however, from the given J values that, as J changes only by 0 or $\pm$ 1 in a transition, the odd terms a,b,c, etc., must all have a J value 3, with the exception of g, r, and s, for which the J values may be 1, 2 or 3 for g, 2 for r and 1 or 2 for s. Each of the terms X, Y, Z, may have J=2 or 3. The term denoted by $^1S_0$ must be one with a J value compatible with the combinations with J=3. Besides, assuming the given J values to be correct, the combinations $^3F_2$—4f 6s $^3F_4$, 5d^2 $^3P_1$—p and 5d^2 $^3P_1$—t involve a change of 2 in the J values in the transition. $\lambda = 2238 \cdot 69$ classified as the combination A—k, differs too widely ($7 \cdot 1$ cm.$^{-1}$) from the calculated value to be correct.

It may be noted that if t has a J value 2, 5d^2 $^3P_1$—t combination would be allowable but then $^3F_4$—t, 5d^2 $^1G_4$—t would both have to be rejected. The large number of odd terms with J=3 indicate that odd configurations other than 4f 5d and 5d 6p must be involved, which in turn should give widely separated terms. It seems that the J values of some of the terms a, b, etc., may not be 3 and that some of the combinations involved may be spurious, as is not unlikely in such a complicated spectrum.

V. D. DABHOLKAR.

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January 15, 1934.

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[1] *Indian Jour. Phy.*, **8**, 137, Oct. 1933.

Castronodus strassenii, G. et sp. n.*
A New Nematode Parasite of *Crocidura cœrula*—the Common Musk-shrew or as it is usually called Musk-rat (Vernacular: *Chachundar.*)

AMONGST the Musk-rats a very heavy infection of this new type of worms prevails in the Hyderabad State. In August 1933, 120 specimens were dissected by me in the Plague Department, Hyderabad City and out of these 37 were found to be infected. The worms occur in nodules in the wall of the stomach. When extracted out of these nodules they are blood-red in colour but turn white after fixation.

The mouth of the worm is surrounded by 6 cephalic papillæ and leads into a buccal capsule which measures 0·05 mm. in length. There are 6 well-developed tooth-like processes projecting into the buccal capsule (Fig. 1). The œsophagus consists of a short

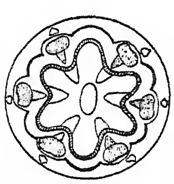

Fig. 1.

Diagrammatic representation of the mouth, surface view.

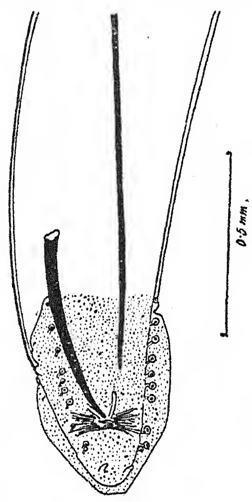

Fig. 2.

Posterior end of the male showing the right spicule, a part of the left spicule, a pair of spine-like process, caudal alæ and the papillæ.

narrow muscular portion and a long, wide glandular part. Its total length is 2·6 mm.

The females are 25 to 40 mm. in length. The vulva lies in front of the posterior end of the œsophagus and is situated at a distance of 1·5 mm. from the anterior end.

The males are 16 to 26 mm. long. They possess caudal alæ and in the mature males there are 7 pairs of pre-anal and 3 pairs of post-anal pedunculated papillæ. Near the tip of the posterior end there are two spine-like processes. The spicules are very unequal. The right spicule measures 0·45 mm. and the left 2·7 mm. in length.

These new nematodes belong to the family *Spiruridæ* (Oerley, 1885), sub-family *Spirurinæ* (Ralliet, 1915). They exhibit some affinities with the genus *Spirocerca* (Ralliet and Henry, 1911) but differ from it markedly and necessitate the creation of a new genus.

The distinguishing characters are as follows:—

(1) Unlike the genus *Spirocerca* in this new genus there are 6 well-developed tooth-like processes projecting into the buccal capsule.

(2) In the males instead of 4 pairs of pre-anal and 2 pairs of post-anal pedunculated papillæ there are 7 pairs of pre-anal and 3 pairs of post-anal papillæ to be found.

(3) The large medium papilla so characteristic of the genus *Spirocerca* is absent here.

(4) Instead of 4 or 5 pairs of minute papillæ at the tip of the posterior end, a pair of spine-like process is present.

The anatomy and life-cycle of this new Nematode will be published elsewhere.

I express my gratefulness to Dr. C. F. Chenoy, Special Plague Officer, Hyderabad City, for giving me all the facilities for the collection of worms.

SATYA NARAIN SINGH.

Zoological Laboratories,
Muslim University,
Aligarh, U.P.
January 20, 1934.

* The Species is named after Geheimrat Prof. Dr. O. zur Strassen of the University of Frankfurt on-the-Main, Germany.

The Melting Point of a Certain Aminodimethoxybenzoylpropionic Acid.

IN connection with the note[1] on this topic recently communicated by Dr. J. N. Ray, it must be at once observed that further experience with the acid in question has shown that its behaviour on heating varies in a somewhat capricious fashion. It depends to some extent on the way in which the sample is dried, and also on the rate of heating. If rapidly heated, the m.p. appears to be approximately 120° in confirmation of Haq, Kapur and Ray (*J.C.S.*, 1933, p. 1087), but if the pure dry acid is heated slowly it

[1] *Curr. Sci.*, 2, 247, 1934.

only sinters at this temperature, hardens again, and melts at various temperatures from 130° to 145°, depending on the conditions of heating. In many cases it is difficult to observe the sintering, and with the technique employed by Miki and Robinson (*J.C.S.*, 1933, p. 1467) the m.p. was found to be 141°. The dehydration of the acid, with the formation of the lactam, evidently occurs on melting, but it is not complete when a specimen of the acid is merely heated in a capillary tube to its point of fusion. It is doubtful whether this acid can be stated to have a melting point which is a physical constant characteristic of its molecular species, and probably all the observed melting points have to do with a substance undergoing more or less decomposition. With Dr. Ray's remarks on the formation of a 7-ring lactam in many cases, the present writer is in complete agreement. However, the acid employed by Miki and Robinson was never melted, and consisted entirely of the amino acid, as shown by its ready solubility in aqueous sodium carbonate and dilute hydrochloric acid, as well as by its diazotizability and by the colour reaction with ferric chloride. It is with amino acid of this kind, and not with the decomposed fused amino acid, that we failed to confirm the condensation to a quinoline derivative, using as second component acetaldehyde under the conditions described by Haq, Kapur and Ray.

Admittedly we made only one experiment, in which, however, we recovered the amino acid unchanged.

In regard to the question of the condensation of the aminodimethoxybenzoylpropionic acid with acetylacetone, and with dibenzoylmethane, Dr. Ray has not quite correctly represented our views on the subject. Miki and Robinson (*loc. cit.*) express no view as to the constitution of these substances, but merely pointed out the necessity for fresh experimental evidence. It will be simplest to reproduce the paragraph of our paper dealing with this subject:—

"Haq, Kapur, and Ray (*loc. cit.*) condensed aminoveratroylpropionic acid with acetylacetone and isolated a product, m.p. 245°. Similarly, the quinolines from aminoveratroylpropionic acid and acetophenone and dibenzoylmethane had m.p.'s 231°-232° and 229° respectively. Carbon and hydrogen estimations are required in order to confirm the view taken of the constitution of the products from acetylacetone and dibenzoylmethane, because the possibility of loss of an acyl residue exists and has not been experimentally disproved."

R. ROBINSON.

Dyson Perrins Laboratory,
University of Oxford,
January 23, 1934.

Chlamydonema fuelleborni n. sp.*

ONE male and nine female specimens of the genus *Chlamydonema* were obtained from the stomach of a domestic cat—*Felis catus domesticus*. The measurements were taken when the worms were alive.

The females measure from 30 to 45 mm. in length and 1·67 to 1·78 mm. in breadth. The body is attenuated anteriorly and the posterior end is enveloped by a reduplication of the cuticle which in the females measures 1·35 mm. from the tip of the tail. The cuticle is transversely striated and reflected over the lips. The cervical papillæ in the male measuring 30 mm. in length are at a distance of 1·16 mm. from the anterior end (Fig. 1). In all the nine females the

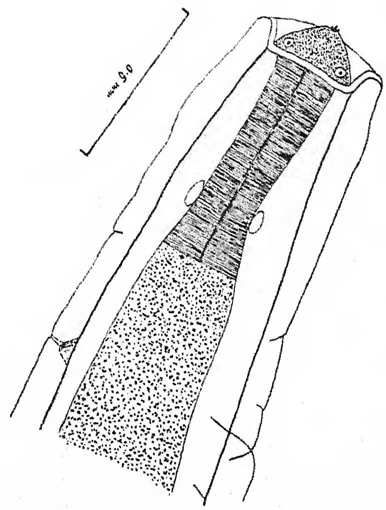

Fig. 1.

Anterior end of male showing the cephalic papilla.

vulva is surrounded by a detachable chitinous ring. In a female 3·5 mm. long, the vulva lies at a distance of 1·15 mm. from

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* Species named after the late Geh. Medizinalrat Prof. Dr. Fredrick Fuelleborn, Director, Institut fuer Schiffs-u. Tropenkrankheiten, Hamburg, Germany.

the cephalic end. The lips and genitalia closely resemble those of *C. præputialis* and *C. masoodi*.

In the male specimen the posterior part of the œsophagus is constricted to a length of 0·93 mm. before it opens into the intestine (Fig. 2). This character is not noticeable in the females and as our observations depend only on a single male specimen, though preserved in an ideal condition, we do not give it any importance until more material is obtained and examined.

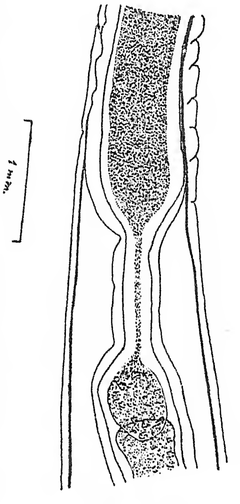

Fig. 2.

Posterior part of the œsophagus of male showing the constriction and a part of the intestine.

The posterior extremity of the male is not entirely enveloped by the reduplication of the cuticula. A little part of the caudal end remains exposed.

As usual there are four pairs of well-developed circumcloacal papillæ. Just above the anus there is a group of three pre-anal ventral papillæ in a line. The middle papilla is the largest. Behind the anus there are two pairs of post-anal ventral papillæ situated in a line. All these four papillæ are small and equal in size. Further down the tail there are four pairs of caudal papillæ. Pairs Nos. 1 and 2 are situated near each other on the anterior part of the caudal end and lie a bit farther off from pairs Nos. 3 and 4, which are situated near each other on the posterior part of the caudal end. The last pair, *viz.*, Papillæ No. 4, are the largest of all the caudal papillæ (Fig. 3). The spicules are unequal, slender, curved and pointed. The left spicule measures 2·89 mm. and the right one 0·81 mm. in length.

We take this opportunity to express our sincere thanks to Dr. Asa C. Chandler, Rice Institute, Houston, U.S.A., for sending us two specimens of *C. præputialis* which he found in a domestic cat at Calcutta. We could not investigate this material thoroughly as the specimens have shrunk to a great extent and moreover both of them happen to be females. The lips and genitalia have, however, a close resemblance with those of *C. præputialis* but in the absence of a male the species cannot be determined.

Four species of the genus *Chlamydonema* have been described so far. This new species discovered by us differs from those already described in the arrangement of the ventral post-anal and caudal papillæ. *Chlamydonema masoodi* (Mirza, 1933), possesses three caudal papillæ arranged transversely in a row. *C. præputialis* (von Linstow, 1889, Hegt, 1910), possesses one pair immediately behind the anus, three papillæ towards the tail end and an additional pair in front of these three. Ortlepp in describing the same species mentions that just behind the anus, one pair immediately following the other, there are three pairs of ventral papillæ and that two additional

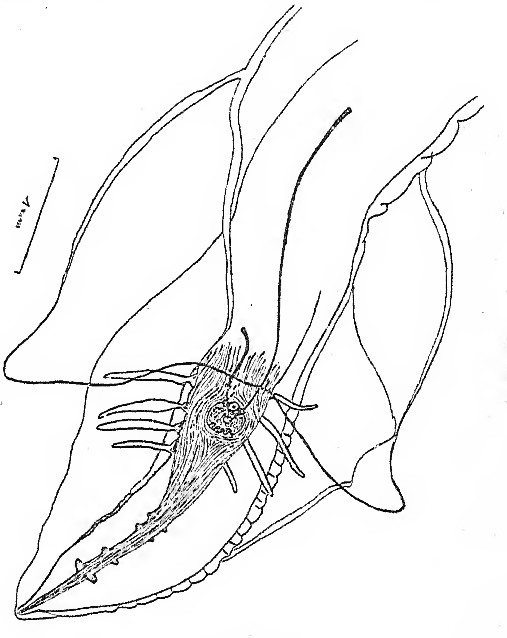

Fig. 3.

Posterior extremity of male, ventral view. The reduplication of cuticula is raised up in order to expose the papillæ.

pairs are found further down the tail. *C. malayensis* (Ortlepp, 1922), has only three pairs on the tail, in addition to this the size of the spicules also differs from our specimen. *C. tumefacien* (Henry & Blanc, 1912), has five pairs of post-anal ventral papillæ, each pair is situated one behind the other.

The arrangement and size of the three pre-anal ventral papillæ in our specimen are just the same as those distinguishing

C. præputialis, *C. malayensis* and *C. tumefacien* but the arrangement and size of the caudal papillæ differ markedly from those of the above four species as already described.

The specimens have been deposited in the Museum of the Zoological Laboratories, Muslim University, Aligarh, U.P., India, under No. 1001.

M. B. MIRZA.

Zoological Laboratories,
Muslim University, Aligarh,
January 25, 1934.

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A Short Note on the Variation in the Strength of Reception of Calcutta Short-wave Transmissions at Chittagong.

THE Calcutta short-wave broadcast is received here with excellent strength and very good quality in the morning and noon, on every occasion. But in the evening, the reception is generally weak, sometimes amounting to no signal at all. The distance of Chittagong from Calcutta is about 200 miles.

The various characteristics of short-wave propagation are explained by assuming the existence of ionised layers in the atmosphere. The first or E layer is at a height of about 90 kilometres, where the ionisation is produced by the ultra-violet radiation from the sun. The short-waves pass through this layer with slight absorption. The paths of the waves are bent in the more strongly ionised F layer, which is at a height of about 250 kilometres. The variation of the ionisation with height at any part of the atmosphere is called the 'ionic gradient" which depends on the amount of radiation from the sun. It has been established that the bending of the short-wave rays is directly proportional to the ionic gradient, and inversely proportional to the frequency. Thus for a given wave-length, the bending is greater at day-time when the sun shines, and less during the night.

It seems that for Calcutta short-waves (49·1 m.?) the ionisation in the F layer during the day-time is sufficient to return the rays to earth at this distance, so that the signals are quite strong. At night, on the other hand, the bending diminishes to such an extent that sometimes Chittagong falls within the skip zone and the reception is very poor at this place.

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Chittagong, Bengal,
January 31, 1934.

An Attempt to Govern Sex Realisation in the Rabbit.

INVESTIGATION of the sex problem from the genetical and general biological point of view may be divided into two parts. First, there is the question as to which elements participate in the determination of sex and whether these may be experimentally governed before sex determination. Secondly, there is the question as to which factors participate in the realisation and manifestation of sex, and whether it is possible to govern such factors experimentally after sex determination but during the period of sex realisation.

According to modern cytogenetics female and male sexes are results of definite chromosomal combinations. Certain combinations of sex chromosomes together with the autosomes are responsible for the determination of males, females and intersexes. The latter can also be conditioned by quantitative genetic factors in various degrees as in *Limantria*. The cytogenetic investigations indicate that the male sex in *Mammalia* contains the heterochromosomic pair, consequently it forms two types of gametes (spermatozoa); one type, the YA, determines the male sex and the other, the XA, determines the female sex. The female organisms, however, form only one type of gametes (egg cells) with the chromosomal constitution XA. Sex determination therefore occurs at the moment of fertilisation; a female (XXAA) is determined if an egg cell is fertilised with an XA spermatozoan and a male (XYAA) is determined if fertilisation is effected by a YA spermatozoan. To

govern sex determination then it is necessary either to eliminate one type of spermatozoan by killing or paralysing it so that only the other type remains active, or to separate in some other manner the two types so that one or the other alone may be used for fertilisation. Attempts to separate the XA from the YA type of spermatozoa have recently been reported as having been carried out by Koltzov using an electric current. In his experiments the XA tends to move to one of the poles and the YA to the other.

What then controls the realisation of sex and can we govern the factors acting during this period of sex realisation?

Results of the recent investigations in the field of physiology of development, including those of the endocrinological and transplantation experiments, show that after sex determination there is a long chain of interacting developmental processes which result in the formation of definite sex organs and glands that secrete hormones which in turn play their part in sex realisation.

When we ask whether it is possible to govern the development of sex we question whether we can in some manner govern some of the developmental processes so that from a XXAA determined organism a male develops or from a XYAA determined organism a female develops. The former type of experiments seem more difficult than the latter because the XXAA constituted organism does not have Y-chromosomes, while a XYAA chromosomal constitution has the characters carried by both X and Y[1] chromosomes. Therefore, attempts to influence the developmental processes of a XYAA organism and to direct them towards realisations of a female organism seem more reasonable. This might be done either by forcing the processes directed by X or by suppressing those directed by the Y (*i.e.*, the XAA and YAA components respectively). In our experiments we chose the latter way. From the works of Abderhalden's school[2] we know that after immunisation with proteins or peptones having complex molecules from certain organs or tissues, age specific and sex specific "Abwehrfermente" are induced as well as the species specific and *organ* specific "Abwehrfermente". Numerous immunological investigations have also shown that antibodies can pass through the placenta. Therefore, if we inject protein from rabbit testes into a fertilised female rabbit we can expect that "Abwehrfermente"[3] can be induced in the female rabbit against the testicular proteins and that these by passing through the placenta may act upon the embryos. If male embryos (XYAA) are present the antibodies might conceivably act against the developmental processes directed by the Y-chromosomes and destroy the products of the latter (more exactly, destroy the testicular proteins of the male embryos). Thus, if the male characters are suppressed it may be supposed that female characters will predominate so that from a XYAA determined organism an apparent female might develop.

A series of such experiments were carried out and the results are summarised in Table 1. The sex ratio in the controls is given in Table 2.

TABLE 1.

No.	Date of mating	Date, type and amount of I injection	Date, type and amount of II injection	Date, type and amount of III injection	Male	Female	Abnormal
1	1931 14/III	14/III. 1 gr. rabbit testes tissue+10 c.c. distilled water crushed together; injected 8 c.c. suspension.	21/III. 2 gr. dry tissue from rabbit testes +20 c.c. water. Rabbit No. 1 injected 4½ c.c. No. 2 injected with 5½ c.c. suspension.	30/III. 1·5 gr. tissue of rabbit testes +15 c.c. water. Injected suspension in No. 1, 5 c.c., in No. 2, 5 c.c. too.	2	5	1
2	..	14/III. 1 gr. tissue of bull testes tissue+10 c.c. distilled water, injected 8 c.c. suspension.					

[1] Recent investigations have shown that the Y-chromosome is not devoid of characters as previously supposed, but also contains genes.

[2] Abderhalden, E. und Buadze, S. 1931. Fermentforschung 13: 137 and 13: 166.

[3] The cytological and histological investigations of implanted testes in female rabbits showed that a very rapid cytolysis occurs in the testicle tissues (Kostoff and Rajably, 1933. Irregular Spermatogenesis and cytolysis in rabbit testes under various conditions). (*In press.*)

No.	Date of mating	Date, type and amount of I injection	Date, type and amount of II injection	Date, type and amount of III injection	Male	Female	Ab-normal
3 4(2)[4]	18/VII ,,	20/VII. 2 rabbit testes crushed with 15 c.c. and left for two hours. The swimming particles dropped at the bottom. 5 c.c. clear extract injected in No. 3 and 5 c.c. in No. 4.	..	..	4	6	
5 6 7(1)	24/VIII ,, ,,	25/VIII. Two testes crushed in 20 c.c. water. Each rabbit injected with 5 c.c. suspension.	29/VIII. Injections repeated as at 25/VIII.	..	7	8	3
8	26/VIII	27/VIII. Injected with 5 c.c. suspension preserved with chloroform under toluol from 25/VIII.	29/VIII. As above.	..	2	3	
9(3)	12/IX	This was a female rabbit in which a testes was implanted subcutan at the left ventral side at 3/IX.	..	..	1	4	
10	12/IX	12/IX. Injected with 5 c.c. suspension of a crushed rabbit testes in 20 c.c. water.	16/IX. Injected with 5·5 c.c. suspension of a dry rabbit testes +20 c.c. water 16/IX. Each received 5·5 c.c. as above.	..	2	4	
11 12(2)	14/IX ,,	14/IX. Injected with extract prepared at 12/IX and preserved in chloroform.	..	..	3 2	2 4	
13	23/IX	23/IX. Injected with 5 c.c. suspension prepared from one rabbit testes +8 c.c. water.	..	..	2	3	
14 15	27/IX ,,	27/IX. Each injected with 5 c.c. suspension from 3 rabbit testes +22 c.c. water.	2/X. Each injected with 5 c.c. suspension preserved by chloroform from 27/IX.	8/X. Each injected with 5 c.c. suspension from 1 testes +12 c.c. water.	3	6	1
				Altogether ..	28	45	5

TABLE 2.

No.	Born at	Male	Female	No.	Born at	Male	Female
					B.F.	20	20
1	10/IV	3	2	8 (4)	18/VII	5	6
2 3	30/IV ,,	6	6	9 (2)	,,		
				10	30/VII	3	2
4	22/V	3	4	11 12 (6)	24/VIII ,,	4	5
5(1)	12/VI	2	3				
6	27/VI	3	2	13	15/IX	2	4
7(3)	8/VII	3	3	14 (3)	21/X	3	3
	C.O.	20	20		Altogether ..	37	40

[4] The numbers given in parenthesis as for example "(2)" mean that rabbit **No. 2** appears now as **No. 4.**

Treated pregnant rabbits together with rabbit No. 9 (in which an implantation was made of testicular tissue rather than an injection) gave 28 males, 45 females, and 5 abnormal individuals. The latter had relatively small penises and testes. The testes were about the size of a pea grain when these animals were dissected at an age of 70 to 100 days. If animal No. 9 is excluded (Table 1) then there were 27 males, 41 females and 5 abnormal individuals among the progeny. In the control animals there were 37 males and 40 females. I am personally not satisfied with the subject used (rabbit) or with the results obtained. The difference between the treated and untreated animals is not very great, but it is suggestive enough to warrant carrying out further experiments. The abnormal individuals may prove to be of great interest from the developmental point of view.

The results given here are therefore far from conclusive, but I am reporting them because at the present time I am engaged with other experiments and cannot continue them further though I think they indicate possible interesting results if more extensively pursued. Governing the sex realisation and manifestation is of scientific significance and may also prove to have practical applications. The swine or dog might prove a better object for experimentation than the rabbit since they have a longer period of gestation and thus would allow for better immunisation of the maternal organism before the beginning of testicular development in the embryos. These animals also bear no less than the rabbit and the gestation period is not too long to give satisfactory time for investigations. Should such immunisation by organ or tissue suspensions or extracts of pregnant animals prove successful for influencing the development of embryos they may help in attacking numerous developmental problems.

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Genetical Laboratory,
Academy of Sciences,
Leningrad, U.S.S.R.,
January, 1934.

[5] The author is indebted to Mr. B. Tranoff for help throughout the investigations here reported.

Rydberg's Potential Energy Function and Transition Probabilities.

WHILE examining by graphical construction, the correctness of potential energy curves for diatomic molecules with the aid of effective integral and $B\nu$ values, Rydberg[1] has proposed a modified function of the following form:

$$U(r) = D\ (ax + 1)\ e^{-ax}$$

This he has found to agree better than Morse's function in the case of H_2, CdH, and O_2.

During my recent work in London on the quantitative estimation of band intensities in the second positive system of N_2, I thought it desirable to examine this function for vibrational transition probabilities. I have derived these theoretically by Morse's as well as Rydberg's functions. From the accurate experimental data of intensities, I have calculated the vibrational transition probabilities by producing the bands in four different sources varying widely in temperature and electrical conditions. The Condon parabola of maximum probabilities on the basis of Rydberg's function has been found to give a much closer approximation than Morse's, with experimental values in all the cases studied. This can be understood from the Table A given below, where the theoretical and experimental results of maximum probabilities are compared. These have been

TABLE A.

Maximum Probabilities.[2]
Positive Column.

Theoretical		Experimental
Morse (1)	Rydberg (2)	(3)
(0, 0)	(0, 0)	0, 0
(1, 0)	(1, 0)	1, 0
(0, 1)	(0, 1)	0, 1
3, 1	(3, 1)	2, 1
(0, 2)	(0, 2)	0, 2
4, 2	4, 2	3, 2
(0, 3)	(1, 3)	1, 3
—	—	4, 3
1, 4	(2, 4)	1, 4
1, 5	(3, 5)	2, 5
2, 6	(3, 6)	3, 6
3, 7	(4, 7)	4, 7
3, 8	—	—
4, 9	—	—

[1] Rydberg, *Zeit. f. Phys.*, **73**, 376, 1931.

[2] The numbers in the table are bands where maximum probabilities have been located.

derived by reading the quantum numbers of bands on or in the immediate vicinity of Condon parabolas. The agreement has been judged graphically by the closeness of theoretical and experimental curves. Those bracketted in columns (1) and (2) denote close agreement with experimental determinations. It may be noted that $r_{min.} \rightarrow r_{min.}$ transitions in the case of Morse function have been found to be relatively far away from the experimental parabola. To avoid unnecessary details, only the results of positive column in discharge tube have been given herewith. Nearly similar results have been obtained with other conditions of excitation.

It is interesting to note that Johnson and Dunston* working independently on the intensities of BeO bands, have arrived at the same conclusion. The detailed results will be published elsewhere.

N. R. TAWDE.

Royal Institute of Science,
Physics Laboratories, Bombay,
January, 1934.

* Johnson and Dunston, *Phil. Mag.*, **105**, 472, 1933.

On Stellar Ionisation.

IN a previous note[1], expressions were given for stellar ionisation for the relativistic as well as for the non-relativistic case with electrons in the degenerate and the non-degenerate state. It was pointed out that with the *total* number density 10^{30} (electrons, ions and atoms taken together) ionisation is complete well within temperatures of the order 10^9—10^{10}. This is in line with the hypothesis of Fowler, Stoner and others[2], who, starting with the hypothesis of complete ionisation, arrive at the limiting density of White Dwarfs of the order 10^{29}—10^{30}. This also accounts for the fact that in the calculation of stellar opacity,[3] the bound-free transition does not make any contribution at all, for in a fully degenerate system there is no bound electron. We are also spared from making the paradoxical assumption with Chandrasekhar that electrons are bound as well as free.

Now in carrying out numerical calculations some interesting points arise. We consider for the present that stellar matter consists of hydrogen only. The results are given in the table.

Star	Temperature	Minimum No. of electrons for satisfying degeneracy criterion.	Percentage of Ionisation			No. of electrons calculated from ionisation		
			Degenerate		Non-degenerate	Degenerate		Non-degenerate
			Non-Relativistic	Relativistic	Non-Relativistic	Non-Relativistic	Relativistic	Non-Relativistic
Model Star $N=10^{30}$	1×10^9	$1{\cdot}54\times10^{29}$	13·9	4·5	32·02	$1{\cdot}22\times10^{29}$	$\cdot43\times10^{29}$	$2{\cdot}42\times10^{28}$
	2	4·34	32·8	32·0	44·58	2·47	2·42	3·08
	3	10·06	94·0	93·0	57·98	4·85	4·80	3·66
	4	12·27	Complete	Complete	65·10	5·0	5·0	3·94
Sirius B $\rho\sim3{\cdot}10^6$	1×10^9	$1{\cdot}54\times10^{29}$	17	..	..	$2{\cdot}55\times10^{29}$	..	..
(Eddington)	$7{\cdot}2\times10^9$	$40{\cdot}12\times10^{29}$	Complete	..	..	18×10^{29}	..	..
$\rho\sim3{\cdot}97\times10^4$	$1{\cdot}5\times10^9$	$28{\cdot}28\times10^{29}$	Complete	..	93·00	$2{\cdot}39\times10^{28}$	..	$2{\cdot}22\times10^{28}$
O_2–Eridani B. $\rho\sim9{\cdot}55\times10^4$	9.7×10^7	$4{\cdot}65\times10^{27}$	15·5	..	..	$8{\cdot}45\times10^{27}$	..	..
	$6{\cdot}6\times10^8$	$8{\cdot}25\times10^{28}$	Complete	..	..	$5{\cdot}45\times10^{28}$	..	..
[4] $\rho\sim8{\cdot}55\times10^5$	9.7×10^7	$4{\cdot}65\times10^{27}$	4·0	..	8·83	$2{\cdot}56\times10^{27}$	..	$4{\cdot}54\times10^{28}$
	$\sim10^{10}$	$4{\cdot}0\times10^{30}$	Complete	..	..	$5{\cdot}14\times10^{29}$	..	..
[5] Chandrasekhar's Model $N\sim7\times10^{29}$	$1{\cdot}4\times10^9$	$2{\cdot}55\times10^{29}$	..	15	..	$\cdot92\times10^{29}$	..	..
[6] Star with limiting $\rho\sim5\times10^8$	5×10^9	$1{\cdot}32\times10^{30}$	2·90	·45	..	$8{\cdot}7\times10^{30}$	$1{\cdot}34\times10^{30}$	..

1 Ganguli, *Curr. Sci.*, **1**, Dec. 1932.

2 Fowler, Stoner, etc., see ref. 1.

3 Chandrasekhar, *Proc. Roy. Soc.*, **133A**, 241, 1931; Kothari and Majumdar, A.N., **244**, 146, 1931.

4 Chandrasekhar, *L. F. Astrophys.*, **3**, 306, 1932.

5 Chandrasekhar, *Monthly Notices, R.A.S.*, **91**, 446, 1930.

6 Stoner, *Ibid.*, **92**, 662, 1932.

It is evident from the table that in most cases the number of electrons calculated from the degree of ionisation for the degenerate case does not satisfy the degeneracy criterion.† On the other hand, the number of electrons calculated from the degree of ionisation for the non-degenerate case for these very stars, leads to degeneracy. This is true for the models considered and also for Sirius B and O_2–Eridani B.

This incipient degeneracy may be avoided with higher electron density corresponding to the given temperatures. Actually, since all stars contain, besides hydrogen, several poly-electronic atoms such as Ca and Fe, the electron density may be expected to be much higher than what is computed here. For these cases, successive ionisation should be taken into account. But since in all cases, ionisation potential affects but little the degree of ionisation in the degenerate case, it may be shown that in this case as well complete ionisation is attained within $T=10^{10}$ for $N \sim 10^{20}$.

A. GANGULI.

Chemical Laboratory,
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January, 1934.

On Transport Phenomena in Degenerate Gases.

RECENTLY Kothari and Uehling and Uhlenbeck[1] have studied the problem of transport in the new Quantum Statistics and have deduced values for viscosity, conductivity and diffusion. We have used Maxwell's method[2] modified by Fermi-Dirac Statistics and have obtained the results of Chapman for the fifth power law in the generalised form. We find the hydrodynamical equation of continuity for the steady state in the same form as in the classical case and the adiabatic gas law

$$\lambda n^{-\frac{2}{3}} = 0 \text{ where } \lambda = \frac{p}{\rho}$$

$$\text{or} \quad p\rho^{-\frac{5}{3}} = \text{Const.}$$

is valid for the degenerate or the non-degenerate case. The expressions for viscosity, diffusion and conductivity are respectively as follows:

$$k = \frac{p}{\mu n}, \quad \theta = akC_v,$$

$$D_{12} = \frac{p}{n} \cdot \frac{1}{m_1 m_2 A_1 (n_1 + n_2)} \sqrt{\frac{m_1 + m_2}{k}}$$

$$\text{and } D = \frac{3A_2 pm}{\mu \rho^2 A_1}$$

where $\mu = \frac{3}{2}\sqrt{2mk}.\ A_2$.

A_1, A_2 and k have the same significance as in the classical theory, $a=5$ for the classical theory and $\frac{15}{14}$ for the degenerate state.

In order to apply this to electrons and protons in the stellar interior we have to use the law of inverse square. Instead of using Chapman's method[3] we have used the more rigorous method due to Perisco[4] and we obtain expressions for viscosity, etc. in the same form with modified value of $\mu = \frac{3}{2} VA_2$ where,

$$A_2 = \pi \int \sin^2 \theta' \; p \, dp,$$

V is the average velocity, and

$$A_1 = 4\pi \int \cos^2 \tfrac{1}{2}\theta' \; p \, dp.$$

Calculations for A_1 and A_2 are made for O_2–Eridani B with density $9 \cdot 8 \times 10^4$ gm./c.c. and $T=10^8$, and assuming this to contain completely ionised Ca atoms. The values of viscosity, conduction and diffusion are given below.

$$k = 11 \cdot 65, \ \theta = 1 \cdot 952 \times 10^{-15} \text{ and}$$

$$D = 2 \cdot 286 \times 10^{-2}.$$

Calculations for other stars are being carried out and the significance of these values to stellar models will be discussed elsewhere.

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P. MITRA.

Science Laboratory,
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Chandernagore,
January, 1934.

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† This has been kindly pointed out to me by Dr. Chandrasekhar in a private communication.

[1] Kothari, *Phil. Mag.*, **13**, 361, 1932; *M.N.*, **92.** Uehling and Uhlenbeck, *Phys. Rev.*, **43**, 552, 1933.

[2] Jeans, *Dynamical Theory of Gases*, 4th Edn. (Cambridge), Chap. IX, p. 231.

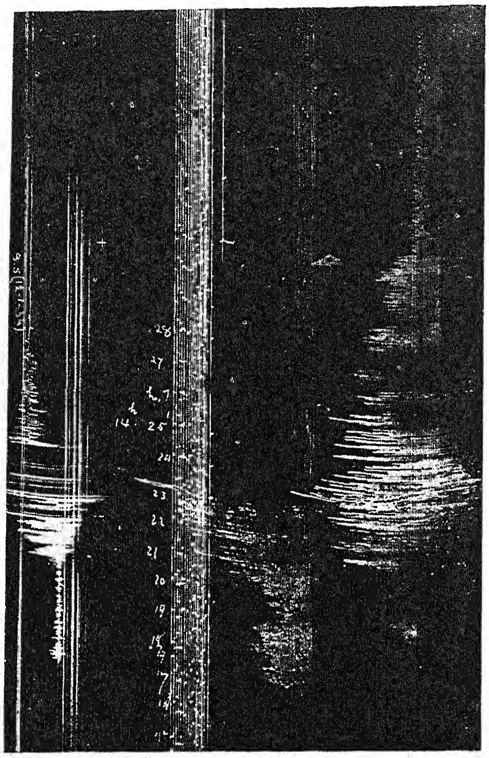
Chapman, *Phil. Trans.*, **216A**, p. 279, 1915; **217A**, p. 115, 1916.

[3] Chapman, *M.N.*, **82**, 291, 1922.

[4] Perisco, *M.N.*, **86**, 93, 1925.

Seismographic Record of the Recent Earthquake.

FROM a photograph of the Seismogram obtained in Mangalore on January 15th, 1934, it may be seen that the movement began at 14 hrs. 17 mins. It continued till



after 15 hrs. (S. T.). The first phase is well marked in the vertical component (extreme left), not so well marked in the two horizontal components. S — P = 3 mins. 20 secs. which according to Zeissig's Tables, gives an epicentral distance of 2,000 Km. (see Galiztin's *Vorlesungen uber Seismometric*, Leipzig, 1914, p. 108). *The Travel Times of Earthquake Waves* published by the Department of Geophysics, Saint Louis University (Nov. 1933) gives a distance of 1,935 Km. This would fix the epicentre within a circle of some 50 Km. radius from Khatmandu (Nepal). The epicentral determination, however, cannot usually be done from data obtained at a single station. In the present case the determination is all the more uncertain that the first tremors are not well marked by the horizontal components. The maximum amplitude marked by the E — W component is 10·4 cms., at about 14 hrs. 23 secs., when the needle broke. Double amplitude is measured, very remarkable is the amplitude of the vertical component. If the jumping of the ground was so pronounced at a distance of 2,000 Km., what must it have been near the epicentre? The St. Louis distances are applicable only to earthquakes whose focal depth is 10–15 Km. They form so numerous a class as to deserve to be called "normal earthquake". The agreement of the measured with the calculated epicentral distance makes me think that the hypocentre of the earthquake of January 15. would not have been much deeper than 10 or 15 Km. Of course, only a study *in situ* can settle the question.

D. FERROLI.

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February 3, 1934.

Organic Manures and Soil Structure.

THE beneficial effect of organic manures in improving the tilth and increasing the absorptive and water-holding capacities of soils has long been known. Their utility as sources of plant and microbial food has been recognised and, more recently, evidence has also been adduced to show that they supply a part of the carbon-dioxide assimilated by the plant.[1] No information is available, however, regarding the effect of their decomposition on the ultimate mechanical composition of soils: indeed, they are not supposed to have any effect at all.

In the course of an investigation on nitrogen transformations in swamp soils, it was observed that soils treated with organic manures tended to become increasingly heavy with the progress of the decomposition. This observation, combined with a few others, such as increased difficulty in 'dry' digesting such specimens for estimation of nitrogen, suggested that the treatments had brought about some permanent change in the physical texture of such soils.

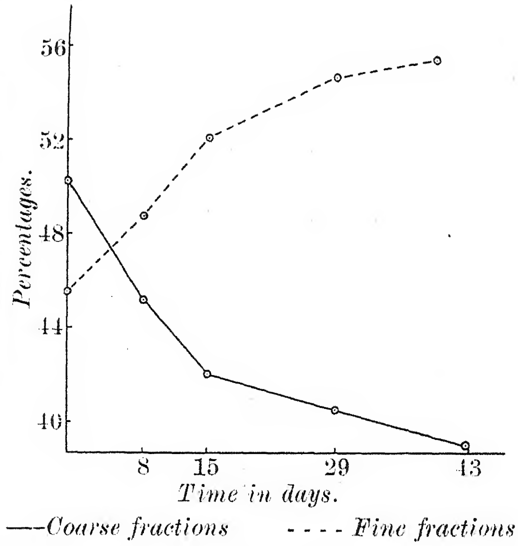
With a view to obtaining some quantitative evidence regarding the nature and extent of such transformations, specimens (40 lbs.) of a local soil (red loam) were made up, in the usual way, in glazed earthenware pots and treated as follows:—(*a*) unmanured and

[1] *Nature*, **132**, 1001, 1933.

maintained at 60 per cent. saturation with regard to water; (*b*) green manured with the leaves of *Pongamia glabra* at 100 g. per pot and maintained at 60 per cent. saturation; (*c*) unmanured and swamped to a depth of 3 inches; and (*d*) green manured as in (*b*) and swamped as in (*c*). At convenient intervals the contents of the pots were removed in three-inch layers and their mechanical composition determined according to the International Method after destroying organic matter by treatment with hydrogen peroxide.

The results showed that in none of the cases was there any perceptible effect on the composition of the soil below the first three inches. The surface layers of the unmanured specimens were not also appreciably altered. On the other hand, the green manured soils showed a significant change with the decomposition of the organic matter. This was particularly so in the case of the water-logged specimens in the first three inches of which the coarse fractions (coarse and fine sand) showed a distinct fall while the fine ones (silt and clay) showed a corresponding rise.

The mechanism of the above change is still not fully understood. There is evidence, however, to suggest that the formation of organic acids and the attendant solubilisation of minerals, particularly silica, is, in some way, connected with the increase observed in the case of the finer fraction.



Further work is in progress to throw more light on the above and related phenomena.

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February 6, 1934.

Loch Ness Monster.

THE belief in the existence of weird creatures is a survival of the dark ages in which the credibility of the people outstripped their understanding and imposed no restrictions on the acceptance of exaggerated accounts of fire-snorting dragons and outlandish monsters. If now and then reports of the occurrence of such strange animals arrive, it is because there are still people whose mind is not sufficiently enlightened to discern and discriminate. Judged by the reports of this modern monster, he is obviously an enormous reptile whose compatriots ceased to exist towards the beginning of the Tertiary period of the Earth's history, for they had reached a complexity of organisation which rendered them incapable of adapting themselves to the new conditions of environment introduced by this period. Those which still possessed that power of adaptation survived as in the case of Sphenodon and it is impossible to conceive of a gigantic Pythonomorph capable of adjusting itself to the new altered conditions of existence or escaping from the more agile enemies. A stray animal, even if it were prehistoric, by which popular writers mean of times before man began to chronicle public events, cannot continue to live indefinitely but must imply the existence of his family and tribe hidden somewhere in the still unexplored regions. Such haunts will not remain long concealed from the scientists, sportsmen, explorers and cinema directors and the only value of the reported occurrence of a monster in Loch Ness is to provide a subject for excited talk in social circles. The scientist wants the evidence

of the animal itself, dead or alive, and after dissection would be able to pronounce his verdict as regards the monster's age, pedigree, relationship and value. The monster may prove a commonplace seal or whale.

A Study of the Citrus Varieties of the Bombay Presidency.

By Dr. G. S. Cheema, D.Sc., I.A.S., and S. S. Bhat, M.Ag.

Introduction.

In order to advance the horticultural possibilities of any tract, it becomes imperative to obtain first-hand knowledge of the existing local conditions of fruit cultivation. A study of all the different local varieties of a group of fruits and their adaptability to the local conditions of soil, climate, etc., is only a preliminary necessity before any attempt can be made towards improvement.

The Presidency of Bombay produces many kinds of fruit of genuine quality. A number of varieties of the citrus group are cultivated here "par excellence". Many foreign types are also being annually introduced by State agency or private enterprise. Some of the local varieties seem to be firmly occupying their ground in point of quality and production. They are perhaps above competition by the new comers. There are also introduced varieties of citrus which may, in course of time, establish themselves as superior in quality and thus gain popular favour. Such varieties may not oust the established local types, but they may occupy new ground side by side with them. There is also considerable confusion about the identity and classification of the local varieties of citrus, when they are compared with those mentioned in foreign literature. This fact presents an almost insurmountable difficulty not only to the student of horticulture, but even to the enterprising grower, who tries to import new types from outside. A free exchange of suitable varieties of citrus is thus much hindered.

An attempt is therefore made in the following pages to assign to the local types of citrus their proper place in the different schemes of classification of citrus attempted by several authors.

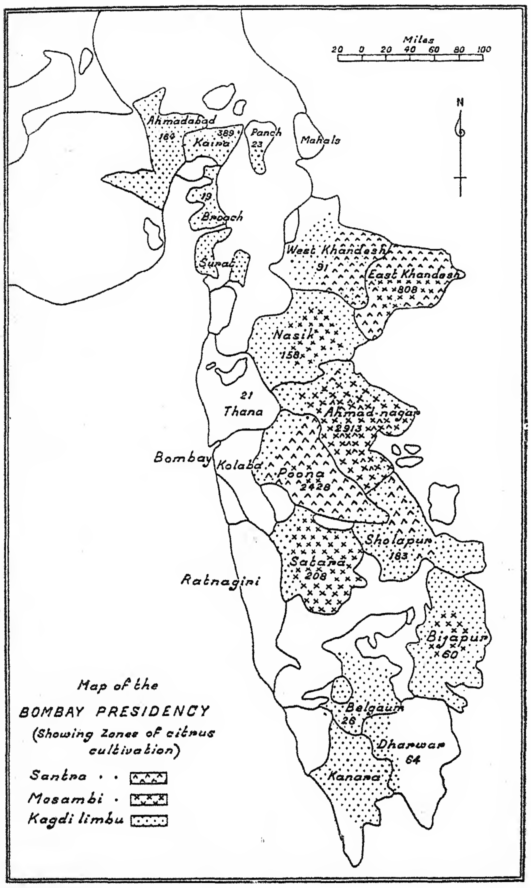
The Varieties of Citrus of the Bombay Presidency and their Importance.

There are a large number of varieties of citrus found growing in this Presidency. Their cultivation is restricted to particular zones only, which are suitable from the point of view of soil, climate, and other conditions, such as facilities for irrigation. The important varieties of this Presidency are the oranges (Santra and Mosambi types), the lime (Kagadi limbu) and the pomelo and the citron group. These varieties are not all found occupying the same zones. They are more or less distributed severally according to suitable conditions. In fact, the oranges and the lime are alone cultivated on plantation scales. The other types are mostly seen scattered as individual trees in the regular plantations of the above varieties.

The total acreage of citrus cultivation in this Presidency comes to about 7,500 acres. The two types of oranges (Santra and Mosambi) alone occupy nearly 5,000 acres of this area. Their distribution is restricted to the Poona (2,198 acres), the Ahmednagar (2,611 acres), and the East Khandesh (671 acres) districts. The other districts have practically very little area under oranges. Then comes the lime (Kagdi limbu) which occupies about 1,700 acres on the whole. Its cultivation is more extensively distributed than that of the oranges. The lime occupies about 400 acres in the Kaira, 300 acres in the Ahmednagar and 250 acres in the Poona districts. The districts of Nasik, East Khandesh, Ahmedabad and Bijapur have about 100 acres each under lime. Beside these there are not less than nine other districts which have lime cultivation on a smaller scale. The pomelo stands last in point of acreage under cultivation, occupying only 23 acres in the Presidency. It is mainly cultivated in the Thana and Kolaba districts although there are odd trees of pomelo almost everywhere, especially in the coastal tract near Bombay (see map in the next page).

From this it will be seen that while there are not less than 20 distinct local varieties of citrus, it is only three or four of them

that are of economic importance at present. They too are now grown in a limited number of districts. With the increase of facilities



of irrigation and transport, it is quite possible that their cultivation will be extended not only in the present citrus growing zones but also in new zones which may be formed in the Karnatak and elsewhere. It is not only the oranges, which are the important table varieties, that hold out this promise, but the lime seems to have a greater future especially with the development of the Lime Juice production industry.

We give in this paper a detailed study of our local varieties of citrus and try to classify them in different groups wherein they may be best fitted.

IDENTIFICATION AND CLASSIFICATION OF THE CITRUS FRUITS OF THE BOMBAY PRESIDENCY.

The present nomenclature of the citrus fruits of this Presidency seems to require a revision when they are compared with those described and illustrated in foreign literature. Many of the local types have their own botanical names, which are locally approved, but they seem to be presenting considerable amount of confusion in finding out their exact prototypes in other countries. Of course, opinions widely differ on the point of the classification and identification of the citrus fruits even among the great American writers on these fruits. Coit[2] states in this connection: "No two systematic botanists appear to be agreed as to the proper classification of the many different species. This is probably due to the fact that several of the species hybridize readily, and it is very difficult to determine which of the forms are of hybrid origin." Not only this. The writers have observed different forms of fruits, which would appear to belong to different types of citrus, growing on the same tree in the case of some varieties of citrus. Bonavia[1] mentions examples of this nature with illustrations abundantly. He differs from Coit and states that a total change of climate, soil, and environment might effect still greater changes in the nature and appearance of the fruit, without any influence from hybridism and without the necessity of origin from a different species. This phase of our study becomes, therefore, greatly complicated and confusing. The desirability of a uniform nomenclature which may be acceptable to all the citrus growing countries of the world cannot be over-estimated. It seems to be, however, practically impossible to be achieved, because of the large number of new types which originate from time to time, the various local names for identical types, and the lack of sufficient communication between the workers of different countries.

An attempt is, therefore, made in these pages to study the various classifications offered by some of the most prominent writers on the subject. It is also intended to fit in our local types of citrus according to the most generally accepted classification and nomenclature. This indeed involves certain alterations in the locally approved botanical names of some of our types.

Bonavia[1] is perhaps the first botanist who made an extensive study of the citrus fruits of India. According to him our local types are named and classified as follows. (See Table No. 1.)

TABLE NO. 1.

Digest of the Classification of Citrus Fruits of India and Ceylon as presented by E. Bonavia, in his "The Cultivated Oranges and Lemons of India, etc.".

Main Group	Characteristics of Main Group	Sub-group	Characteristics of Sub-groups	Names of local types falling in these groups	Botanical Names
1. Oranges	Flowers white; fruit red, spherical, without a mammilla. (The author states that there is no good *natural* reason to take these points as characteristic of oranges.)	I. *Sweet oranges:* (*a*) Portugal, Malta. Naval, Mosambi.	Tree spreading, Fruits close-skinned; taste more or less purely sweet.	Mosambi, Naval and Malta oranges.	*Citrus aurantium sinense*, Gall.
		(*b*) i. Santra.	Tree slender, erect; fruit loose-skinned; juice of Santra is sweet well blended with sour; that of Keonla and Mandarins is more acid than sweet.	Santra.	*C. aurantium sinense*, Rumph.
				Kavla, Ladu, Reshmi narangi.	Do. (*C. nobilis* of Laureiro is a synonym.)
		ii. Keonla and Mandarins.		China orange.	*Bigaradier chinois.*
		II. *Sour oranges:* (*a*) Seville.	Fruits are sour in taste, loose-skinned; more or less akin to Santra, except that Khatta and Karna may vary in size.	Seville or Sylhet orange.	*C. bigaradier* Risso. *C. fusca*, of Laureiro. *Aurantium acid* of Amboyna. *C. vulgaris*, Risso or all synonyms.
		(*b*) Khatta or Karna oranges.	Do.	..	*C. aurantium*, var. Khatta, Bonavia.
2. Pomelos	"Petiole broad-winged; flowers large, white; stamens 16-24; fruit large, pale, globose, or pyriform, rind thick; pulp sweet or acrid."	i. Pulp red or pink. ii. White. iii. Pulp mixed, entirely yellow. or red-checked.	..	Pomelo, Shaddock or grape fruit (Papnas)	*C. decumana* Linn.
3. Citrons, Lemons and Limes.	"Young shoots glabrous, purple; leaflet glabrous; flowers often uni sexual; petals generally more or less pink; fruit globose, ovoid, or oblong, often mammillate at the apex."	i. *C. medica* proper.	"Leaflet oblong; petiole short, margined or not; flowers usually numerous; fruit large, oblong, or ovoid; mammilla obtuse; rind usually warted, thick, tender, aromatic; pulp scanty, sub-acid.	Mahalung.	*C. medica* Linn. (*C. aurantium* var. *medica* of Brandis is synonym.)
		ii. *C. medica* var. *Bajoura.*	Lemon-citron, and citron-lemon.	..	*C. medica* var. *Bajoura.*
	"A shrub or small tree; leaflet 3—6 inches; elliptic-ovate, or ovate-lanceolate; petiole naked or winged; flowers 5-10 in a raceme, small or middle-sized; stamens 20-40."	iii. *Sour:* (Lemons) *C. medica* var. *limonum.*	"Leaflet ovate; petiole margined, or winged; fruit middle-sized, ovoid, yellow, mammillate, rind thin; pulp abundant, acid."	Jamburi and Id limbu.	*C. medica* var. *limonum*. (*C. aurantium* var. *limonum* of Brandis. *C. limonum* Wall. *C. medica*, Will. are synonyms.)
		Sweet (lemon): *C. medica*, var. *limmetta.*	"Fruit globose, 3-5 inches diameter; rind thin, smooth, juice abundant, sweet, not aromatic."	Sakhar limbu.	*C. medica* var. *limmetta* or *lumia*. (*C. limmetta* Risso is synonym.)
		iv. *True limes.*	"Leaflet elliptic-oblong; petiole many times shorter than the leaflet, linear or abovate; racemes short, flowers small, petals usually four; fruit usually small, globose or ovoid, with a thick or thin rind; pulp pale, sharply acid."	Kagdi limbu (thin-skinned). Godhadi limbu (thick-skinned).	*C.M. acida* Linn. (*C. acida* of Roxburgh.)

Bonavia does not present any distinct scheme of classifying the citrus fruits. He only discusses the suitability of certain groups and critically examines certain distinctive characters. He devotes a chapter for almost every one of the sub-groups mentioned in the table. It is true that these are all considerably different from one another. All the same, they seem to fall under certain main groups, which are shown in the table.

Coit[2] in his book "Citrus Fruits" expresses the great difficulty of properly classifying the various kinds of citrus fruits, and after studying the various schemes proposed, he offers the following "practicable working classification". Coit's scheme certainly gives a bird's-eye view of the important species of citrus. He does not enter into the details of the many sub-varieties of the species, but only groups them in general into broad specific groups. The following Table No. 2 presents Coit's classification together with the grouping of the Bombay citrus varieties under the different heads.

TABLE No. 2.

Coit's Classification.

Botanical Name	American Varieties	Equivalent Bombay Varieties
Citrus trifoliata.	The deciduous orange *Poncirus trifoliata.*	*Citrus trifoliata* (wide tree).
C. bergamia.	Bergamot orange.	
C. sinensis.	Common sweet orange.	Mosambi, Naval orange, etc.
C. aurantium	Sour stock, seville or bitter orange.	Seville, Sylhet, Khatta orange.
C. nobilis.	The king orange. var. *deliciosa*—Mandarin oranges, etc. var. *unshiu*—Satsuma oranges.	Santra orange. Kavla, Ladu, Reshmi narangi.
C. decumana.	The pomelo (grape-fruit), shaddock.	Pomelos (Papnas).
C. japonica.	Kumquats.	China orange. (?)
C. medica.	Citron of commerce.	Mahalung.
C. limonia.	Sour lemon, sweet lemon.	Jamburi, Id; Sakhar limbu.
C. aurantifolia.	Sour lime, sweet lime.	Kagdi limbu, Godhadi limbu and Pat limbu.

Professor Tyozaburo Tanaka of Japan has offered a classification of the citrus fruits of the Eastern countries. He offers an elaborate scheme and remarks that more species may be recognised as knowledge of these fruits will gradually advance. In his opinion the earlier workers on classification worked only on superficial characters. He credits Dr. Swingle of having taken a long step towards a standard classification of citrus fruits in the scheme he has offered, consisting of nine definitely known species as the standard. Prof. Tanaka points out the mistake of taking Swingle's nine species as final and further states that "The faithful application of the type theory and the establishment of horticultural species admited by the Vienna Code are the most important phases in completing the taxonomy of citrus fruits". He proceeds to say that in classifying citrus fruits fundamental importance must be attached to essential characters only. Such are, according to him, the difference in inflorescence, elongation of anther and pulp vesicles, colour of the embryo, polyembryony or mono-embryony, etc. In elucidating these characters, Prof. Tanaka states: "Polyembryony generally prevails in *Citrus*, *Poncirus* and *Fortunella*, but mono-embryo is a distinctive character in Shaddock citron, lemon, Yuzu, Ichang lemon, and in certain loose skin oranges." Regarding this character, the experience of the present writers is somewhat different. In a germination trial, they have found that citron (Mahalung) and lemon (Jamburi) seeds have shown that a large percentage of them are *polyembryonic*. The importance of this character as of specific distinction in classification seems to be therefore doubtful

to the writers. Professor Tanaka's classification is given below together with an attempt to fit in the Bombay varieties according to it.

TABLE NO. 3.

Tanaka's Classification of Citrus Fruits and the Place of the Bombay Varieties.

Main Group	Varieties and their Botanical Names	Bombay Varieties falling in them
1. *Papeda.*	*Citrus Hystrix* DC. *C. macroptera*, Mont. *C. micrantha*, Wester. *C. Webberi*, Wester.	
2. *Lime.*	*C. aurantifolia* (Christm.) Swingle.	Kagdi limbu, Godhadi limbu, Pat limbu.
3. Lemon-Citron.	*C. medica*, Linn. *C. medica gaoganensis* (Hayata), Tanaka. *C. limon*, Linn. *C. limonia*, Osbeck. *C. limonia otaitensis*, Tanaka. *C. bergamia*, Risso and Poit. *C. limetta*, Risso.	Mahalung (citron). Jamburi and Id lemon. Sakhar limbu.
4. *Shaddock-Intermedia.*	*C. maxima* (burm), Merril. *C. paradisi*, Macf. (grapefruit). *C. intermedia*, Hort. (nov). *C. kotokan*, Hayata. *C. glaberima*, Hort. (nov).	Pomelo (papnas).
5. *Sour-Sweet Orange.*	*C. aurantium*, Linn. *C. sinensis*, Osbeck. *C. taiwanika*, Tanaka and Shimada. *C. tankan*, Hayata. *C. medioglobosa*, Hort. (nov). *C. natsudaidai*, Hayata, etc., etc.	Seville or sour orange. Mosambi and Naval oranges.
6. *Yuzu-Ichangensis.*	*C. junos*, Sieb. sec. Tanaka. *C. ichangensis*, Swingle.	
7. *Loose-skin Oranges.*		
(*a*) *Nobilis.*	*C. nobilis*, Lour. *C. unshiu*, Marc. *C. yatsushiro*, Hort. (nov).	Kavla, Ladu and Reshmi narangi.
(*b*) *Deliciosa.*	*C. deliciosa*, Ten.	
(i) fruits large.	*C. poonensis*, Hort. ex Tanaka. *C. genshokan*, (Hayata) Hort. *C. tangarina*, Hort. ex Tanaka, etc., etc.	Santra.
(ii) fruits small.	*C. kinokuni*, Hort. ex Tanaka. *C. ponki*, (Hayata) Hort. (nov), etc., etc. *C. suntara*, Hort. *C. keonla*, Hort.	
(*c*) *Mitis.*	*C. mitis*, Blanco.	China orange (?).

Hume[4], in his book "The Cultivation of Citrus Fruits" (1926), discusses some of the most important considerations which have made the standard classification of citrus fruits most complicated. He states that the various distinct types of citrus ought to be recognised as different species. This suggestion, Hume says, is followed by Swingle,[5] and therefore he accepts Swingle's scheme of classification in his work. Swingle has raised the Trifoliate orange group and the kumquats to the status of new independent

genera, *Poncirus* and *Fortunella* respectively, as they differ in many essential characters from the other species of citrus. The following table shows in short the scheme of classification of citrus types offered by Swingle, as also how the Bombay varieties of citrus may best be accommodated in it.

TABLE NO. 4.

Swingle's Classification and the Bombay Varieties of Citrus.

Species of Citrus according to Swingle	Synonyms	English Names	Bombay Varieties
1. *Citrus medica*, Linn.		Citron.	Mahalung.
var. *sarcodactylis*, Swingle		Fingered citron.	
2. *C. limonia*, Osbeck.	*C. medica*, var. *limonum*. Linn. *C. limonium*, Risso.	Lemons.	Jamburi & Id limbu.
3. *C. aurantifolia*, Swingle.	*Limonia aurantifolia*, Christman. *C. limetta*, Auct.	Limes.	Kagdi and Godhadi limbu. Sakhar limbu.
4. *C. grandis*, Osbeck.	*C. aurantium*, var. *grandis*, Linn. *C. decumana*, Linn.	Pummelo, grape fruit, shaddock.	Papnas.
5. *C. aurantium*, Linn.	*C. vulgaris*, Risso. *C. bigaradia*, Risso. *C. aurantium*, var. *bigaradia*, Hook.	Sour or Seville orange.	
6. *C. sinensis*, Osbeck.	*C. aurantium*, var. *sinensis*, Linn. *C. aurantium* Lour.	Sweet oranges.	Mosambi, Malt and Naval oranges.
7. *C. nobilis*, Lour.		King orange.	Kavla, Ladu, Reshmi.
var. *deliciosa*, Swingle.	*C. deliciosa*, Tenore.	Mandarins.	Santra.
var. *unshiu*, Swingle.	*C. nobilis*, subsp. *genuina*, var. *unshiu*, Makino.	Satsuma.	
8. *C. mitis*, Blanco.			
9. *C. ichangensis*, Swingle.			

DISCUSSION.

In the light of the foregoing study, it may be stated that the scheme of classification offered by Swingle[6] has gone a long way towards solving this complicated problem. The principle involved in this scheme accepts the separation of differing types into species. Swingle's list of citrus species will gain in number with the advance of knowledge, as Tanaka[7] has remarked. With this modification, therefore, it may not be unreasonable to believe that in due course of time, the foundation laid down by Swingle will be greatly strengthened, and the super-structure of a standard classification of citrus fruits will be materially constructed on it.

It becomes now essential to assign to the Bombay varieties of citrus the positions they deserve in the general classification of citrus fruits. In doing so, the writers propose to abide by the scheme offered by Swingle with Tanaka's modification to add more species to it.

The oranges of Bombay fall into two distinct groups, namely, the close-skinned oranges, and the loose-skinned oranges. They have all been considered till now to belong to a single species. Their common botanical name has been *Citrus aurantium*.[5]

Bonavia[1] differentiates these two groups into *C. aurantium sinense*, Gallesio (the close-skinned oranges), and *C. aurantium sinense*, Rumphius (loose-skinned oranges). But these two groups widely differ in many points, and fortunately, they rightly fall into two separate species according to the scheme of Swingle. The close-skinned Mosambi group of oranges goes under *Citrus sinensis*, Osbeck, and the loose-skinned Santra group goes under *Citrus nobilis*, Lour. There are further what may be called horticultural varieties in these species. *C. sinensis*, Osbeck includes the Mosambi* orange, the naval orange and others. Of these the Mosambi is perhaps a distinct variety and is at present of great economic importance in this Presidency. The writers think that it deserves to be recognised as a separate variety, and may be called *C. sinensis*, var. *mosambi* Hort. The other varieties like the Naval orange and the Malta orange are already recognised as such.

The *Citrus nobilis*, Lour. group has no less than four different types grown in this Presidency. They are the Santra, the Kavla, the Ladu, and the Reshmi narangi. The Santra is perhaps the best of the loose-skinned types of oranges. Tanaka[7] appreciates it as unequalled in quality and names it *Citrus poonensis*, Hort. ex Tanaka. It is therefore already accepted as a distinct horticultural variety. The other types are inferior to the Santra orange. They are also different from one another and may be considered as separate horticultural varieties. They may be then named *C. nobilis* var. *kavla* Hort., *C. nobilis* var. *Ladu* Hort., and *C. nobilis* var. *reshmi narangi* Hort.

Then come the citron, the lemons, and the limes. They were all till now considered here as only varieties of *Citrus medica* according to Linnius. In the new scheme of Swingle they fall into three separate species —*C. medica*, Linn. (citron); *C. limonia*, Osbeck (lemon), and *Citrus aurantifolia*, Swingle (limes). The fruits of Bombay present at least three types under *C. limonia*, Osbeck; they are Jamburi, Id limbu, and Sakhar limbu. The Jamburi and the Id limbu are sour lemons, while the Sakhar limbu is a sweet lemon. The former may be separated by independent botanical names, *C. limonia*, var. *jamburi* Hort., and *C. limonia* var. *Id limbu* Hort. respectively. The Sakhar limbu or sweet lemon has run till now by the name *C. medica* var. *limetta*, Linn., of which *C. limetta*, Risso was only a synonym. As all the lemons fall into one species, according to the scheme of Swingle, *C. limetta*, Risso will have to sink itself in *C. limonia*, Osbeck. It can, however, retain its identity by being recognised as *C. limonia* var. *limetta* Hort.

The limes too form a separate species, *C. aurantifolia*, Swingle, and include as varieties of Bombay, the kagdi limbu, the godhadi limbu, and the pat limbu. The godhadi limbu has a somewhat thicker skin than the kagdi limbu. The pat limbu is longish in shape while the others are globose. These varieties also may be considered horticultural varieties, and named accordingly. They will then stand as *C. aurantifolia*, var. *kagdi* Hort., *C. aurantifolia*, var. *godhadi* Hort., and *C. aurantifolia*, var. *pat* Hort.

* Mosambi is a corruption of Mozambique, from where this variety must have been brought to India.

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The Indian Association for the Cultivation of Science, Calcutta.

THE annual grant of Rs. 20,000 which the Central Government has been awarding to this institution has suffered a cut on account of the financial stringency and the offer of Rs. 18,000 for the next financial year by the Standing Finance Committee of the Assembly was based on the report of the Educational Commissioner with the Government of India who inspected the institution in September last. We have always thought that it is an extremely short-sighted policy to curtail subsidies to research institutions in general and in particular to those whose work has earned for India a distinct position in the world of international science. The inveterate tendency on the part of Governments to measure the value of scientific research in terms of its practical applicability to the administrative affairs is hard to cure and the utilisation of its results for increasing the material wealth of the Nation, while necessary and important, must be subordinate to the claims of wider knowledge and deeper penetration into the mysteries of Nature. Judged by this standard, the Indian Association for the Cultivation of Science under the inspiring guidance of Sir C. V. Raman has achieved remarkable results and his successor Dr. K. S. Krishnan whose zeal and devotion for scientific research are well known, requires perhaps greater financial encouragement than has hitherto been accorded to the Association. Scientific work should not be made to depend on the financial vicissitudes of Government, for its orderly and uninterrupted progress must be assured of a steady and satisfactory income, without subjecting the grant to be based on "a review of the position and the work of the Association annually".

The 150th Anniversary of the Asiatic Society of Bengal.

ON the 15th January the Asiatic Society of Bengal celebrated the 150th anniversary of its foundation by an afternoon conversazione in the Indian Museum, and a banquet in the evening followed by a special anniversary meeting. The Conversazione was attended by the Mayor of Calcutta and about five hundred ladies and gentlemen, the leading citizens of Calcutta. It took the form of a garden party on the lawn of the Museum and special and most interesting collection of exbibits, consisting of paintings lent by the Academy of Fine Arts, copies of old documents from the Imperial Records Department, mostly of the eighteenth century and some concerning the Asiatic Society, paintings of plants from the Botanical Survey, Javanese and Siamese sculptures from Dr. S. K. Chatterji, chemical and physical processes in action by the University College of Science and Technology, prehistoric and tenth century finds from the Archæological Survey, fossils, crystals and economic products from the Geological Survey, birds of Bengal from Dr. S. C. Law, diseases, their prevention and treatment, by the School of Tropical Medicine and Hygiene, medals and coins by His Majesty's Mint, Kaffir attire, fish, crustacea and insects from the Zoological Survey.

The Banquet was honoured by the presence of His Excellency Sir John Anderson, Governor of Bengal, who is the Patron of the Society, and took place in its 126 year old hall, surrounded by portraits and busts of former members who have made history in Bengal. Ninety-three members and guests took part, including the Consular representatives of France, Germany, Holland, Sweden and the United States of America, the Archbishop of Calcutta, the Hon. Sir M. N. Roy Chowdhury, Sir David Ezra, the Hon. Nawab K. G. M. Faroqui, Sir C. C. Ghose, the Hon. Sir A. K. Ghuznavi, Lord Sinha, the Hon. Sir B. P. Singh Roy, and Sir Jadu Nath Sircar. The toast of the Guests was proposed by the President, Dr. L. L. Fermor, to which Mons. J. Delacour of the National Museum of Paris replied, and also proposed the Asiatic Society, but speeches were brief in view of the meeting afterwards.

At the Special Anniversary Meeting His Excellency the Governor took the chair and the President delivered his Anniversary Address, outlining the history of the Society and naming the distinguished contributors to its publications, more especially in the last half century. He pointed out that many of the specialist departments and institutions founded in India originated from

the Asiatic Society, in particular the Indian Science Congress, and mentioned the proposals which had been made for the formation of an Indian Academy of Sciences to effect co-ordination between these various interests in the sphere of science.

Following the President's Address, congratulatory messages were read from His Excellency the Viceroy, the Mayor of Calcutta, the League of Nations, Prof. C. Rockwell Lanman, Sir George Grierson, and Sir Thomas H. Holland, Honorary Fellows. Seven addresses were read from the British Museum, the Linnean Society, the Zoological Society of London, the Batavian Society of Arts and Sciences, the Indian Institute, Oxford, the Schopenhauer Society, Frankfurt, and the Prussian Academy of Sciences. Congratulations were presented by 26 delegates from 58 learned institutions, and in all 19 countries were represented,—Australia, Austria, Belgium, Ceylon, Canada, France, Federated Malay States. Germany, Great Britain, Hungary, Italy, Japan, Netherlands, Spain, Sweden, Switzerland, Tasmania, United States and India.

In his speech His Excellency the Governor stressed the vigour of the Society in spite of its age, its permanence since the days of the French Revolution, and the esteem in which it is held abroad, as manifested by the spontaneous tributes received from all over the world. He drew attention to the traditional connection of the Ruling Princes with the Society, and hoped that this tradition might be widened, to the benefit of scholarship, by the inclusion in the Society's list of members of the name of every substantial Ruler in the country.

His Excellency paid special tribute to three members of the Society, Sir Rajendranath Mookerjee, Mr. Johan Van Manen, the General Secretary, and Dr. S. L. Hora, the Honorary Secretary of the Celebration Committee.

Research Notes.

Separation of the Heavy Hydrogen Isotope.

IN *Die Naturwissenschaften*, **21**, p. 884, 1933, Prof. G. Hertz describes experiments performed by him in collaboration with H. Harmsen and W. Schütze to separate the heavy hydrogen isotope by means of the new separating apparatus developed by him. (A description of this apparatus has already appeared in a previous note in this journal.) Since the two isotopes of hydrogen have masses in the ratio of one to two, separation by diffusion should be easiest in this case. The hydrogen was produced by the action of magnesium vapour on the water in an electrolytic cell. Since this hydrogen contains H_2^1 and H^1H^2 molecules with only a very few H_2^2 molecules, a discharge tube was introduced at a suitable point of the apparatus so that H_2^1 and H_2^2 molecules were produced from the H^1H^2 molecules. In this way the H^2 isotope was obtained in such purity that discharge tubes filled with this gas after fully degassing the electrodes did not show even a trace of the ordinary hydrogen lines. The paper contains two interesting photographs, one giving the H_2 line of H^1 and H^2 taken on the same plate and the other giving the many-line spectrum of hydrogen from tubes containing ordinary hydrogen, a mixture of the two isotopes in nearly equal proportions and pure heavy hydrogen respectively, all taken on the same plate. In this way one can distinguish between the lines of H_2^1, H^1H^2 and H_2^2 and the comparison is very instructive. Further details are to appear in the *Zeitschrift für Physik*.

Experiments on the Adiabatic Cooling of Paramagnetic Salts.

In *Physica* (1, 1, 1933) W. J. de Haas, E. C. Wiersma and H. A. Kramers describe experiments in which extremely low temperatures were sought to be obtained by the sudden demagnetisation of paramagnetic salts kept at the temperature of liquid helium. A sample of the salt was kept surrounded by liquid helium at a point in the field of a big electromagnet where $H\frac{\partial H}{\partial x}$ was a maximum. The sample was thermally well isolated and shut off from radiation. It was thus kept in the high constant magnetic field till it had acquired the temperature of the liquid helium. The field was then suddenly decreased and the force on the sample was then determined as a function of the time. Knowing the force immediately after the decrease in the field

and also its value in the same small field at the temperature of liquid helium, the lowest temperature reached could be calculated, assuming the product of susceptibility χ and absolute temperature T to be constant. Because of the assumption of the constancy of χT the estimated temperature is only an upper limit. The specimen thus serves as its own thermometer.

The following table shows the results obtained:—

Date	Salt	Lowest Temperature Reached
6th April	CeF_3	0°·27 K.
24th May	,,	0°·19 K.
15th June	Dy ethyl sulphate	0°·15 K.
7th July	,,	0°·12 K.
,,	Ce ethyl sulphate	0°·10⁵ K.
,,	,,	0°·08⁵ K.

In a note added in proof, the authors report the conclusion of experiments with potassium chromic alum which gave a calculated lowest temperature below 0°·05 K. The authors remark that because of its cheapness, its high moment which leads to saturation even under low fields, and its regular crystalline shape which removes difficulties of orientation, this salt is best suited for experimental production of the lowest temperatures.

Diffraction of Light by Supersonic Waves.

R. BÄR (*Helvetica Physica Acta*, **6**, 570, 1933).

THE diffraction patterns resulting from the diffraction of light by supersonic waves obtained by the method of Debye and Sears (*Proc. Nat. Acad. Sci.*, **18**, 409, 1932) are reproduced in the paper. These photographs show that the intensity of the individual diffraction pattern is a function of the order of interference, showing maxima and minima. The position of these maxima and minima is a function of the intensity of the supersonic rays, the value of the ratio of the wavelength of the supersonic waves to that of the light waves, and also of the distance traversed by the light rays through the supersonic waves. Using the method developed by the author and Meyer (*Phys. Zs.*, **34**, 393, 1933) for obtaining photographs of supersonic wave fields in liquids, the diffraction of a supersonic wave by a wire grating has been investigated. Photographs are also given showing the reflection and refraction of supersonic waves at the boundary between two liquids, *e.g.*, with p-Xylol above and water below.

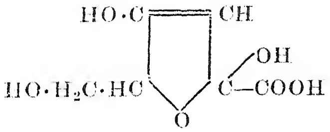
Ascorbic Acid.

SZENT GYÖRGYI isolated from the cortex of the suprarenal capsules, a strongly reducing acid, $C_6H_8O_6$, which is also widely distributed in plants and animals (*Biochem. J.*, **22**, 1387, 1928). This acid answers the colour reactions given by carbohydrates. King and Waugh isolated an identical substance from lemon juice (*J. Biol. Chem.*, **97**, 325, 1932). Györgyi's acid was originally named hexuronic acid because it was supposed to be derived from some non-specified hexose in the same way as glycuronic acid is produced by the oxidation of glucose in the animal body. But, later work has shown that it is not a member of the uronic acid group. In view of its strong antiscorbutic activity, Haworth and Györgyi have altered the name to ascorbic acid (*Nature*, **131**, 24, 1933).

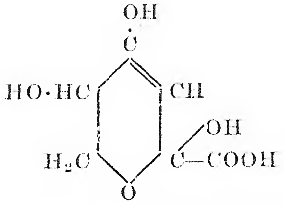
The essentially complete parallelism existing between the antiscorbutic activity and the ascorbic acid content of plant and animal tissues has been pointed out by Harris and his co-workers (*Biochem. J.*, **27**, 303, 1933). This acid does not owe its antiscorbutic activity to any contamination with a highly active substance, for the acid liberated from the thoroughly purified mono-acetone derivative, is strictly identical with the original substance and possesses undiminished antiscorbutic activity. Ascorbic acid is now regarded as vitamin C in a pure crystalline form (Szent Györgyi, *Nature*, **131**, 225, 1933).

The remarkable chemical property of the acid is its high reducing power. When oxidised by iodine in acid solution, a dehydro acid is formed which is still antiscorbutically active. This acid can be reduced to the original acid by hydrogen sulphide or hydriodic acid. Colour reactions with ferric chloride and sodium nitroprusside are indicative of an enolic group; the presence of a double bond is deduced from its reaction with tetranitromethane, with which a deep yellow colouration is produced (Karrer, Salomon, Schöpp and Morf., *Helv. Chim. Acta.*, **16**, 181, 1933). The presence of a primary alcoholic group is evidenced by the formation of a triphenyl methyl derivative. The formation of a di-*p*-nitro phenyl hydrazone shows the presence of two carbonyl groups. One of these is adjacent to the carboxyl group, since oxidation with hydrogen peroxide readily yields oxalic acid. On the basis of these observations Karrer,

Schöpp and Schwarzenbach suggested I A and I B as the probable alternative formulæ for ascorbic acid (*Helv. Chim. Acta.*, **16**, 302, 1933):

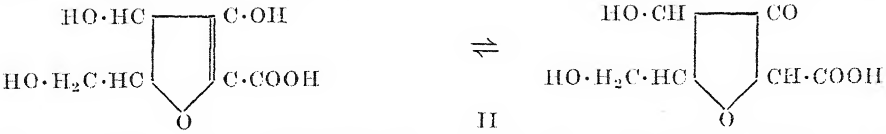


I A



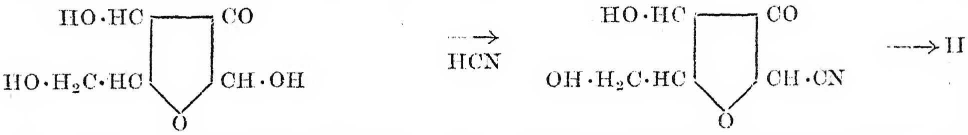
I B

Micheel and Kraft, however, favoured the structure II (*Nature*, **131**, 274, 1933):

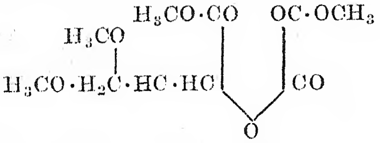


II

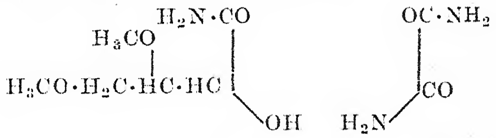
This formula was in harmony with Reichstein, Grüssner and Oppenauer's original interpretation of their synthesis of the dextro isomer of ascorbic acid (*Helv. Chim. Acta.*, **16**, 561, 1933)



Based on a study of methyl derivatives and other reactions of ascorbic acid, Hirst and his collaborators have arrived at an entirely different structure (*Nature*, **131**, 617, 1933; *J. Chem. Soc.*, **299**, 1270, 1933). Ozonisation of the tetramethyl derivative of ascorbic acid results in the rupture of the pre-existing double bond and the formation of a neutral product III identified as methyl-3 : 4-dimethyl-1-threonate, substituted in position 2 by a methyl oxalate residue. This product on treatment with methyl alcoholic ammonia yielded oxamide IV and 3 : 4-dimethyl-1-threonamide V:

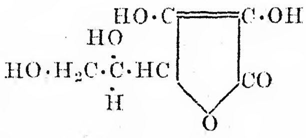


III



V IV

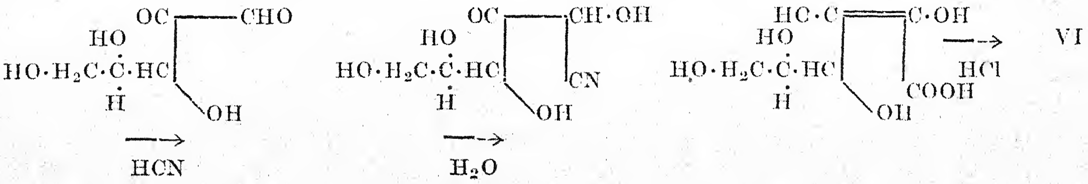
These observations are easily explained by the structure VI given by them to ascorbic acid:



VI

This also accounts for the formation of l.-idonic acid by catalytic hydrogenation and of formaldehyde by the oxidation of dimethyl ascorbic acid with lead tetra-acetate (Micheel and Kraft, *Z. physiol. Chem.*, **218**, 280, 1933). This is also more in harmony with the X-ray data of the crystalline material, which demands an extraordinarily flat molecule (Cox, *Nature*, **130**, 205, 1932).

The synthesis by Reichstein, Grüssner and Oppenauer (*Helv. Chim. Acta.*, **16**, 1019, 1933) and Haworth and collaborators (*Jour. Soc. Chem. Ind.*, **52**, 645, 1933; *Jour. Chem. Soc.*, **332**, 1419, 1933) is now explained thus:



The reaction between acetone-dimethyl-ascorbic acid and magnesium methyl iodide gives additional support for the lactone formula (Karrer, Schöpp and Zehnder, *Helv. Chim. Acta.*, **16**, 1161, 1933). The analytical results of the product of reaction agrees closely with those to be anticipated on the basis of VI.

P. R. KRISHNASWAMY.

Blister Rust of Pine.

BLISTER rust is a fungus disease attacking young pine plants causing considerable damage to the healthy regeneration of this valuable species. As in the case of other rusts, the organism belongs to the group of heteroecious fungi which pass their life cycle in more than one host and the inadequate knowledge of the alternate host in the present instance, was responsible for the slow progress on the subject although the fungus (*Peridermium himalayense*) was isolated long ago. The occurrence of rusts on plants which form constant associates of pine acting as the possible alternate stage of this fungus, the identification and description of new organism, its biological relationship to the chir parasite, and the control measures for checking the spread of this pest after elaborate studies, form the subject of a contribution by Dr. K. Bagchee (*The Indian Forest Records*, Botany Series, **18**, Part 11, 1933).

The author discovered in the course of his studies that certain annual plants belonging to the genus Swertia were found always associated with pines in the pine stands, and that some species of this genus suffered from a rust disease the most prominent of which was *Swertia alata*. Strangely enough where pine was not diseased, these species also were free from infection. The several sylvicultural observations relating to the occurrence and spread of these diseases are recorded by the author. It occurs from the above that an inter-relationship possibly exists between the pine rust and Swertia attack. In fact, a biological inter-relation has been definitely established in this publication between the accidial spores of the *Peridermium* and the *Cronartium* fungus which is the cause of Swertia infection. The latter is visible only in a few species of Swertia but not in all. This new fungus is named as *Cronartium himalayense*, and its morphological characters are described in the paper at great length.

A variety of inoculation experiments with the æcidiospores of the coniferous rust fungus were carried out under controlled conditions on the Swertia plants. In a fortnight's time the *Cronartium* stage of infection was actually reproduced on the new hosts. The various conditions, such as humidity, temperatures, the quantity of the inoculum and the age of the inoculated plant for successful infection, have been worked out by the author. The incubation period extends generally from 7 days to 3 weeks for all the hosts examined. This successful transmission gives the direct clue to short distance transference of the disease in nature to the pine plants, through the widely distributed Swertia plants acting as alternate hosts to the organism. The long distance dissemination can be assumed to be caused by wind-borne æcidiospores. In the field, these spores gain access into the plants through the stomata of the leaves. Thus the infection spreads to the broad-leaved hosts (*Swertia Sp.*) during the early monsoon rains and re-infection of pine takes place through sporidia derived from the germinating teleutospores during the latter part of the monsoon. The several stages of the rust fungus, such as æcidiospores, teleutospores, uredospores and sporidia characteristic of such organisms are detailed. The phenomena of over-wintering of the various spore forms does not appear likely. The æcidiospores do not over-winter in the pine plants. The alternate hosts, being annuals, do not permit the fungus to over-winter in the uredostage.

Thus the control of these rusts is a problem of supreme importance. The introduction of pines resistant to the disease, derived from foreign localities, is beset with considerable difficulties. Other diseases not known locally should not be imported and the successful generation of those plants should be ensured under new environmental conditions. The indigenous pine species have not yielded encouraging results. Several sylvicultural operations, such as admixture of pine with other species, departmental burning, etc., have proved difficult. The control of the chir rust is easy if one of the hosts can be eradicated. In this case, the alternate host being an annual, seems to be apparently easy to get rid of. The author has suggested a scheme of operations to check the malady by destroying the Swertia plants soon after the rains till early autumn. But it is rightly feared that

the same for several reasons may not find favour with the authorities, although a trial will not be a useless proposition. It is suggested here, however, that the increasing application of chemicals for the removal of the annual weeds—Swertia here is actually a weed—is a virgin field for investigation and it is hoped the same may commend itself to the author and to the authorities. It is sure to be cheap, efficacious and simple.

V. I.

The Tongue of *Rana hexadactyla.*

In an interesting article in the *Records of the Indian Museum* (Vol. **35**, part II, 33) C. P. Gnanamuthu describes how exactly the tongue in the frog is brought into action. According to the older authors either the pressure due to the lymph was responsible in exserting the tongue or the muscles, genio-glossus and hyo-glossus acted as protractors and retractors respectively. The present author clearly points out that the hyoid muscles subserve a different function; the two muscles genio- and hyo-glossi are the only ones concerned in governing the movements of the tongue. The muscle hyoglossus remains in a contracted state and is relaxed when the tongue is pushed forward; the dorsal part of m. genioglossus reduces the length and breadth of the tongue while the basal part serves for the pivotal movement of the anterior part of the tongue.

The Thermal History of the Earth.

Arthur Holmes has published a very interesting paper on "The Thermal History of the Earth" in a recent number of the *Jour. Washington Acad. Sci.* (Vol. **XXIII**, No. 4, 1933). In this paper the physical assumptions involved in the various hypotheses bearing on the earth's thermal history are reviewed, in the light of what is known of the actual behaviour of the earth. The Thermal Contraction Hypothesis of Jeffreys and the Hypothesis of Thermal Cycles of Joly have both been critically examined and found untenable. The hypothesis of Sub-crustal Convection Currents advocated by Bull and Holmes is next considered and is shown to give a reasonable explanation for the distribution of mountains in space and time, for the associated geosynclines and oceanic deeps, and for igneous activity in general.

The New Mineralogy.

In a recent number of the *American Mineralogist* (Vol. **XVIII**, No. 3, March 1933) A. N. Winchell has a very important paper on what he calls 'The New Mineralogy'. The author first describes the various ways by which minerals vary in composition and illustrates the relations between these variations and variations in optic properties, giving a new diagram of the diopside-hedenbergite-clinoenstatite system. He states further: "It is only very recently and very gradually becoming apparent that any fixed and definite composition within the limits of variation of any mineral has fixed and definite physical characters. This correlation of physical and chemical properties was impossible in many cases as long as the mineralogist had no key to unlock the door of his crystal palace. Now that he has entered these palaces, he has learned for the first time to understand how they vary in composition; such a knowledge was necessary in order to make it possible to show the relations between physical characters and chemical composition. The aim in the scientific studies of minerals should no longer be merely the name of the mineral but the determination of the precise composition in terms of end-members and for this purpose, accurate measures of optical constants are second in importance only to complete chemical analyses of carefully purified samples."

Carotenoids and Flavines.

In a paper presented before the Leicester Meeting of the British Association for the advancement of Science, Richard Kuhn has discussed the properties of these important colouring matters. The first products of synthesis in plants are dye-stuffs with 40 carbon atoms, and these undergo oxidative disintegration into carotenoids with fewer carbon atoms. The α, β and γ carotenes are provitamins A. The widely distributed yellow, water-soluble colouring matters fluorescing with green are the flavines. Lactoflavine prepared from milk promotes normal growth in rats deprived of vitamin β_2. The flavines can be reversibly reduced, and these act as transporters of oxygen in the cell. When combined with carriers of high molecular weight they appear to act as oxidation enzymes. The properties of the carotenes and flavines appear to be complementary in many respects.

Science News.

Paper from flowering bamboos.—The exhaustive experiments conducted at the Forest Research Institute by Mr. Khaja Nizamuddin, B.Sc. Tech., A.M.C.T. (Manch.), Paper Expert, Commerce and Industries Department, Hyderabad, a description of which is incorporated in a bulletin recently published, clearly show that flowered bamboo even after four years' standing, though dry and dead, retains its paper-making qualities, and can therefore be profitably exploited for paper manufacture. The flowered bamboos are immune to the attack of boring beetles and this is a great point in favour of the utilisation of such bamboos. Severe drought in bamboo forests leads to exhaustive flowering, and the fear that such flowering interrupts the supply of raw materials, has now been dispelled. Samples of papers prepared from flowered bamboos, which have been attached at the end of the pamphlet show their highly satisfactory character, and it is hoped that capitalists would come forward to exploit the scheme for paper manufacture outlined in the bulletin (No. 4) issued by the State Department of Industries and Commerce.

* * *

Indian Chemical Society.—The Tenth Annual Meeting was held at Bombay on the 4th January, Dr. Gilbert J. Fowler, D.Sc., F.I.C., presiding. The Secretary's report for the year 1933, and the Treasurer's statement of accounts for the same year were adopted. Dr. J. N. Mukherjee moved a resolution of the Council to the following effect:—"Resolved: (*a*) That there be only one kind of membership, as regards the eligibility to hold office or to vote, provided that the persons other than in *statute papulaire*, belonging to any branch of the profession of chemistry, who are in receipt of a salary of Rs. 150 a month or less may apply to be exempted from Rs. 10 of the annual subscription and that the Journal and other scientific publications excepting Annual Report and supplementary publications relating to industrial matters will not be supplied to them. (*b*) That all such cases shall be approved by the Council on the recommendation of the local Branch where it exists. (*c*) That the Secretary of the Bombay Branch be requested to draft rules with a view to circulate them to the members of the Council for consideration. (*d*) That rules are to be circulated to other branches.

Sir J. C. Bose was unanimously elected Hon. Fellow of the Society.

The Council's nominations for the publication committee were unanimously accepted. The Committee consists of (1) Dr. S. S. Bhatnagar, (2) Dr. V. Subrahmanyan, (3) Dr. T. S. Wheeler, (4) Dr. H. K. Sen, (5) Mr. B. Viswanath, (6) Dr. J. N. Ray, (7) Dr. J. C. Ghosh, (8) Dr. A. C. Sircar, (9) Dr. P. Neogi, and (10) Mr. P. Ray.

Mr. P. Ray was elected Hon. Secretary, Dr. P. N. Neogi, Hon. Treasurer and Messrs. P. C. Nandi and T. K. Raychoudhury, Hon. Auditors for the year 1934. The following members were elected to the vacancies in the Council for the different centres. Ordinary Members for *Calcutta:* Dr. U. N. Brahmachari, Dr. R. L. Datta, Dr. Sudhamoy Ghosh, Rev. Father J. Van Neste; *Bombay:* Dr. K. G. Naik; *Bihar & Orissa:* Dr. R. C. Ray; *C. P.:* Dr. A. N. Kappanna; *S. India:* Dr. B. B. Dey, Sir M. O. Forster, Dr. S. N. Chakravarthi, Dr. B. L. Manjunath; *U.P.:* Mrs. Sheila Dhar, Dr. S. S. Joshi, Dr. R. F. Hunter; *Punjab:* Dr. H. B. Dunnicliff.

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Society of Biological Chemists, India.—The Third Annual Meeting was held at Bombay on the 6th January 1934. The following members have been elected office-bearers for the year 1934:—*President:* Rai Bahadur Dr. Upendranath Brahmachari, M.A., M.D., Ph.D., F.A.S.B. *Vice-President:* Dr. Gilbert J. Fowler, D.Sc., F.I.C. *Members:* Prof. R. H. Dastur, M.Sc., F.L.S. (*Bombay*); Dr. P. E. Lander, M.Sc., D.Sc., I.A.S., F.I.C. (*Lahore*); Dr. J. A. Iswaramurthi, B.A., L.M. & S., B.S.Sc. (*Bangalore*); Mr. C. S. Rama Iyer, B.A. (*Pusa*); Dr. H. K. Sen, D.Sc., D.I.C. (*Calcutta*); Dr. K. C. Sen, D.Sc. (*Muktesar*); Lt.-Col. J. A. Sinton, V.C., O.B.E., I.M.S. (*Kasauli*); Rao Bahadur B. Viswa Nath, F.I.C. (*Coimbatore*); Dr. M. Damodaran, D.Sc., F.I.C. (*Madras*); and Mr. D. Narayanamurti, M.Sc. A.I.C., A.Inst.P. (*Dehra Dun*). *Secretary:* Mr. B. N. Sastri, M.Sc., A.I.C. *Treasurer:* Dr. V. Subrahmanyan, D.Sc., F.I.C. *Hon. Auditors:* Dr. B. T. Narayanan, Ph.D., and Mr. B. N. Banerjee, M.Sc.

It was resolved that (1) the members of the Society convey their best thanks to Rai Bahadur Dr. Upendranath Brahmachari, M.D., etc., for the donation of Rs. 100 made to the Society and for his generous assurance to give annually a donation of Rs. 100 for the next four years; (2) the members of the Society convey their best thanks to the Council of the Indian Institute of Science, Bangalore, for the generous grant of Rs. 200 to the Society.

* * *

Institute of Chemistry of Great Britain and Ireland.—At a meeting of the Associates and Fellows held during the Science Congress Week at Bombay, it was resolved to start an Indian Branch of the Institute of Chemists with the following objects:—

(1) To establish helpful relations among all Members of the Institute resident in India.

(2) To enable local meetings of social and technical character to be held as occasion arises, either of the Members of the Institute independently or in co-operation with other scientific bodies in the neighbourhood.

(3) To hold an annual meeting of the Indian Section on the occasion of the Indian Science Congress at which matters affecting the interests of the Members of the Institute may be discussed.

A strong committee was appointed to work out the details with Mr. G. W. Douglas, Director of Agriculture and State Chemist, Bhopal, as Secretary.

* * *

Archæological Discovery in Delhi.—Khan Bahadur Maulvi Zafar Hasan, Deputy Director-General of the Archæological Survey of India, has recently discovered the long-lost site of the Hall of a Thousand Pillars (Kasr-i-Hazar Satun) one of the glories of mediæval Delhi, among the ruins of Siri, the second of the Seven Cities, a quarter of a mile off the Qutb Road. Careful comparison of the position of the large mounds which were observed in the ruined city of Siri, in relation to

other buildings that have already been identified, and the study of the ancient documents have confirmed the view that the mounds had covered the royal palaces of the Great Allauddin Khilji. This great Hall when fully excavated will form a notable addition to the Khilji remains in Delhi. It may be recalled that about the year 1550, Sher Shah destroyed Siri, the city founded by Allauddin Khilji in 1303. The famous Hall of a Thousand Pillars which was used as a Royal Palace, was also demolished by Sher Shah who used the materials of the destroyed city for constructing a new town of which the famous *Purana Qila* was the citadel.

* * *

Biological Control of Epidemic Diseases in Mysore.—Remarkable results have been obtained by the Health authorities in Mysore in the control of Malaria, small-pox and other diseases by employing larvicidal fishes like Italian *gambusia* which have been systematically popularised. These results were recently demonstrated before Doctor Paul F. Russell of the Field Staff of the International Health Division, Dr. Victor G. Heiser, Associate Director, Rockefeller Foundation, Dr. John Fitzgerald, Director of the University of Toronto, Prof. W. W. Jameson, Dean of the London School of Hygiene and Tropical Medicine and Dr. Jacocks (Colombo) who are visiting the Health Centres in India, to study the various problems of public health in which the Rockefeller Foundation is interested and gain some first-hand knowledge of medical work in India. The visitors were impressed with the results of the Mysore experiments which have attained unique records in Health Control.

* * *

Possibilities of Fruit Canning in India.—Under the auspices of the Society of Biological Chemists, India, Dr. D. V. Karmarkar, M.Sc., Ph.D., delivered a very interesting address on "Fruit Canning" on Tuesday, the 30th January 1934 in the Biochemistry Lecture Hall, Indian Institute of Science. In the course of his address the lecturer said, "The Canning Industry in the United Kingdom is at present in a thriving condition but it will have its limitations as the supply of fruit is sure to become the determining factor. In these days of Empire Preference, therefore, I do not see why India should not have a trial at this industry. England as at present will continue to remain the biggest buyer of canned fruits. Australia, South Africa, Malay States and other parts of the Empire have already established this industry and, in my opinion, it is high time that India also makes a start.

"India is at present doing very little in this direction. It is possible to utilise the Indian tin plate for the manufacture of suitable cans. The different sugar factories helped by the sugar research stations recently started promise us a good and cheap supply of sugar. India claims to grow different kinds of fruits in plenty and if necessary, can grow more of them. There is no want of highly skilled research workers. What we need at present is a start in the right direction and proper organisation for creating a market at home and abroad."

* * *

Research in 1933.—Under the title "A Rip Van Winkle View of Ethics in 1933" (*The Chemical Age*, **29**, 589, 1933), Prof. H. E. Armstrong has expressed in his characteristic way his views on modern chemical research. The following extracts reproduced from the Professor's article may prove interesting to readers of *Current Science*:—

"The world, to-day, is a world of scientific discovery of overmastering importance; unfortunately, it is also predominantly, a world of advertisements to serve commercial ends. The condition I deplored 15 years ago has now grown intolerable. Scientific workers are openly serving two masters; they almost glory in riding with the hounds while running with the hare. Not only is the world, in general, in the throes of a merciless civil war of commercial competition; equally in the scientific world, ruthless civil war rages between individual workers. Each one for himself, the devil take the hindermost, is the prevailing doctrine in the struggle for place and purse; perhaps also to satisfy the artists' craving for praise and applause. No sooner is an idea started than harpies from everywhere pounce upon it.

"Last year, there was a competitive international rush to secure the rights of vitamin D, in which our state laboratory, under the direction of the Medical Research Council, won by a short neck: a six-man team was engaged upon the work. This year the appointed work of the Birmingham University laboratory has been interrupted, in order to solve a similar sensational problem, in connection with the supposed vitamin C; on this a whole crowd was engaged. Who held whose hand, who washed out which test tube, is not stated. When the expected prize is allotted, how is it to be apportioned? Will each of the workers be presented with a framed certificate (See *R. Soc. Arts Journal*, Dec. 8, p. 109) and a penny whistle, so adjusted that, when he proceeds to blow his trumpet, the squeak will be of proportionate loudness? Obviously the race was against time for priority. What must be the moral effect upon students of such methods of working, of such training?

"Four-fifths of the work that is published in the Journals may be set down as of slight account: no one considers it; it is too unfinished or too trivial in subject. We have in some way to collect the few grains of gold and scrap the rest. Titles must be shortened and made rational, many are too absurd. 'Scaffold Poles and Mortar Moments'—to a floppy mass of Mortar flung about without rhyme or reason, to no obvious end. The label 'Parts I to infinity' is meaningless attached to accounts which should never have had a beginning.

"All said and done, however, there is some gold to be found that glitters. Wisdom is coming from the plant and is passed on to ourselves. A mighty future may well be in store for chemistry. If worthily pursued, it may well be called upon to take charge of public well-being. We know that we ourselves live wholly bedrugged lives. Now we are learning that the plant is equally controlled—that cell growth in the young plantlet takes place under the influence of a definite growth agent termed *auxin*. Although this is present in most minute proportions, it has been isolated in the crystalline state. The composition of Auxin is $C_{18}H_{32}O_5$. The story is a veritable romance. The discovery is the work of the combined physiological and chemical forces of the Utrecht School, under Professors Went and Kogl. The proof is simple. When the tip of the young oat seedling

(the coleoptile) is cut off, the shoot ceases to grow; growth re-commences when it is restored or even if the cut-off tip be placed, for a time, on a fragment of agar jelly and this fragment alone is placed upon the cut surface of the shoot. The agent is thus shown to be soluble. The amount present is perhaps one part in half a million of the plant material.

"Equally remarkable is the discovery in milk of *Lactoflavin*, referred to in *The Chemical Age* of December 16. Assuming this to be correctly represented as the B_2 advitant, the isolation of the substance from milk is of the greatest importance. There has been no public beating of drums over either discovery and no general rush to do work of this character is noticeable. Yet it is the work of the future, for which real chemists must be specially and fully trained. The outstanding task of difficulty will be the precise determination, by competent chemists and physiologists working in unison, and animal activity effect their distinctive purposes. Chemistry may be said to be full of vitality, because its outlook is becoming increasingly vital: in this special connection, of ever-growing public importance."

* * *

Damage caused to the Cotton Crop by White Fly.—The life history of the white insect which causes considerable damage to the cotton crop has been recently worked out by the entomological section of the Punjab Agricultural Department (*Indian Trade Journal*, Jan. 4, 1934). It has been observed that the attack on the early sown crop is greater than on the late crop. The pest is met with all the year round and the duration of the life cycle of the fly is about 18 days during the warm months, April to October; it extends over 107 days during the other months. As a result of the attack the reproductive activity of the cotton plant is interfered with. The bud and boll formation is indirectly proportional while the bud and boll shedding is directly proportional to the intensity of the white fly attack. Further the infested plants produce a less number of seeds per boll and a lower lint percentage than those kept free from infestation. As control measures, application of nitrogenous fertilisers and increased number of irrigations are recommended. Spraying with rosin compound in the ratio of 1:6 has given very encouraging results both with regard to the mortality of the pest and the subsequent yield.

* * *

The Hilger Vitameter-A.—Adam Hilger, Ltd., 98, King's Road, Camden Road, London, N. W. 1, England. (Hilger Publication No. 191/2.)

This booklet describes a new means of testing the Vitamin A chromogen content of cod and other fish liver oils, a most important matter in the successful medical application of these substances.

The apparatus (for which patents have been applied in Great Britain and abroad) measures the absorption of the solution for radiations in the immediate neighbourhood of 3280 Å and is based on the spectrophotometric method of test. Measurements are made visually by comparing the intensity of two fluorescent areas and rendering them equal by a photometric device whose scale gives readings that are a direct measure of the Vitamin A chromogen content.

The makers claim that the method is more convenient and better suited to use by comparatively unskilled operators than those hitherto adopted.

The possibility of the use of this apparatus at all stages of the processes of extraction, refining, blending and distribution, even by comparatively unskilled labour, should render it of great interest in the associated industries.

* * *

Asiatic Society of Bengal.—At the annual meeting of the Society held on 5th instant, Mr. Johan Van Manen, the Secretary, presented the annual report. The membership at the close of the year stood at 436. During the year under report the Society received numerous valuable Persian, Arabic and Hebrew Manuscripts from Mr. Hafeez Abdul Gafur and Sir David Ezra. In spite of the fall in the income due to economic depression, the Council have decided to continue their programme of publication during the next year for which adequate provision has been made in the budget and it is hoped that the arrears into which the Society's Journal has fallen, will be made good in the coming year.

Dr. L. L. Fermor who presided on the occasion read a message from His Excellency the Governor of Bengal and announced the biennial award of Barclay Memorial Medal to Dr. R. Row of Bombay for research in Medical and Biological Sciences and the triennial Anandale Memorial Medal for Anthropological research to Dr. Eugene Dubois.

Dr. L. L. Fermor was re-elected President of the Society, and Mr. Johan Van Manen continues as General Secretary.

One of the most interesting events of the meeting was the election of Mr. D. N. Wadia as a Fellow of the Society and this brings the roll of Fellows to its full complement of fifty. Practically the saturation point has been reached since the institution of Fellowship in 1910. Mr. Wadia occupies the foremost rank among the Indian Geologists and the honour conferred upon him is a fitting recognition of his eminent position as a researcher. His numerous friends will feel gratified and we ourselves offer him our heartiest congratulations. Mr. D. N. Wadia is a Scientist and one of the finest types of gentlemen whom we know and esteem.

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Fellow of the Chemical Society.—Sir Profulla Chandra Ray is one of the distinguished chemists who was recently elected Honorary Fellow of the Chemical Society.

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Andhra University.—At a recent meeting of the Syndicate of the Andhra University held at Waltair, it is understood that the question of extending the jurisdiction of the Andhra University to the Ceded Districts was considered and the view expressed by the Syndicate was, that Anantapur was to be, in that event, one of the chief centres of University activity.

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Life after Death.—Dr. William Brown who is Wilde Reader in Mental Philosophy at Oxford University, in a recent address before the Survival League at Caxton Hall, expressed the view that Science admitted a possibility on the question of whether the soul or spirit of man survives after the death of his body. While the evidence offered by such phenomena as mediumistic trances is very unreliable from the scientific standpoint, it is not impossible that psychological inquiry will yield results that would admit of the possibility of a

survival of the spirit after the death of the body. While the question is claimed to be religious and philosophical, the results of psychical research would certainly add to our knowledge of this question.

* * *

Man's Minimum Diet.—The controversy that is now raging between the Ministry of Health and the British Medical Association representatives of the Public Assistance Committee in England over the question of the minimum diet that is necessary for a man is worthy of attention. Regarding the question of the minimum quantity of food that is to be provided for an unemployed adult to keep him in health and working capacity, the special committee appointed by the British Medical Association after very careful examination, came to the conclusion that the minimum diet was to be 3400 calories and 54 grammes of first class protein. Another committee appointed by the Ministry of Health prescribed a lower figure, *i.e.*, 3000 calories and 37 grammes of protein. This has led to a controversy wherein the advisory committee of the Ministry of Health has come in for a lot of criticism.

The point at issue is one which is more scientific than political and while probably the lower figure is enough to sustain the individual, no reserve energy could be guaranteed in case of sickness and no wastage could be permitted. And it is also interesting to note that in peace time the soldier gets a ration of 62·7 grammes of first class protein.

But one is led to think that with all the meagre diet that the Government have prescribed for the unemployed, England's destitutes are very much happier than those anywhere else in the world. India, where the unemployment figures are most appallingly high and where the State does not come to the aid of the unemployed, it is hard to think where we come in the classification of Men.

* * *

Dr. V. G. Deshpande, College of Agriculture, Poona, writing on the "Out-break of Millipedes," says that Millipedes are known to be vegetable feeders and are always found in the fields and gardens especially in wet places among plants and in decaying vegetable matter. Until the year 1932 at least in this part of India they were never reported to have done any damage to cultivated crops. In that year in the month of July at Jalgaon Farm, East Khandesh, the young seedlings of jowar, tur, and groundnut were destroyed by these millipedes all of a sudden appearing in enormous numbers. The damage was considerable, so much so, that the jowar crop had to be resown. In the year 1933 exactly in the month of July on the same farm the appearance of these millipedes was noticed, but the damage was not much in jowar crop. The reason was that there was a break in the rains for about a fortnight and three repeated inter-culturings, which were necessary for the crop to enable it to hold out without rains, checked them, whereas, last year the conditions were different on account of the wet season. However, in the Cotton Breeder's area the out-break was very serious. The Cotton Breeder reported that the damage done to cotton plants in the pedigree culture (where every plant had its value) would have been enormous were it not for the severe campaign that was set up against these animals. The enormity of the numbers can be judged from the fact that no less than two millions of these animals could be hand-picked and destroyed from an area of two acres only within the course of four days. The amount of money spent for the collection was about 50 rupees besides the use of a tin of kerosene oil for destroying them. These millipedes have been identified by Professor Silvestri of Portici, Italy, as a species of *Spirostreptus* allied to Sp. *modestus*.

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We acknowledge with thanks the receipt of the following:—

"Nature," Vol. 132, Nos. 3346 to 3349.

"The Chemical Age," Vol. 29, Nos. 755 to 758.

"The Journal of Chemical Physics," Vol. 1, No. 12.

"Berichte Der Deutschen Chemischen Gessellschaft," 66 Jahrg, No. 9.

"Natural History," Vol. 34, No. 1.

"Journal de Chimie Physique," Tome 30, No. 9.

"The Review of Scientific Instruments," Vol. 4, No. 12.

"Scientific Indian," Vol. 10, No. 60.

"Indian Forester," Vol. 60, No. 1.

"Forschungen Und Fortschritte," Jahrgang 10, Nos. 1 and 2.

"Supplement 56th to the Bulletin of Applied Botany of Genetics and Plant Breeding of the Lenin Academy of Agricultural Sciences in U.S.S.R.

"The Indian Trade Journal," Vol. CXI, Nos. 1437 to 1440.

"Monthly Statistics of the Production of certain selected Industries of India," Aug. and Sep. 1933.

"Forest Research in India, 1932-33," Part II.

"Canadian Journal of Research," Vol. 9, Nos. 5. and 6.

"Journal of Agricultural Research," Vol. 47, No. 9.

"American Journal of Botany," Vol. 20, No. 10.

"Science Progress," Vol. 28, No. 111.

"Contributions from Boyce Thompson Institute," Vol. 5, No. 4.

"Journal of Agriculture and Livestock in India," Vol. 3, Part 6.

"The Indian Journal of Veterinary Science and Animal Husbandry," Vol. III, Part 4.

Reviews.

ADVENTURES OF IDEAS. By A. N. Whitehead, F.R.S., F.B.A. (Cambridge University Press, 1933.) Price 12*s.* 6*d.* net.

At a time when systems of philosophy are not quite in fashion, two great thinkers have had the courage to formulate closely reasoned and well-knit systems of metaphysics, Alexander and Whitehead. Both of them are not only well versed in scientific thought but possess a broad culture which makes their writings somewhat interesting even to the inexpert. Of the two, however, Whitehead is more difficult to follow. He expounds his metaphysical views in a series of works, the chief of them being *Science and the Modern World*, *Process and Reality*, and the present one. The thesis of the present work is thus stated by the author:

"The book is in fact a study of the concept of civilisation, and an endeavour to understand how it is that civilised beings arise. One point, emphasised throughout, is the importance of Adventure for the promotion and preservation of civilisation" (p. vii).

In the first part of the book, some of the great ideas which have moulded our civilisation, such as the essential rights of human beings, freedom and equality, tolerance are traced to their origin and their slow issue into practical results developed. The growth of civilisation is said to be the victory of persuasion over force. The divine element in the world is for Plato a persuasive spirit rather than a coercive agent.

In the second part, Whitehead turns to the discussion of the influence of scientific ideas and the more general cosmological notions on European culture. Taking up the conception of a law of nature, he discusses the four views of the law as immanent, as imposed, as the observed order of succession or mere description and conventional interpretation and draws out the metaphysical implications. In Whitehead's view, science and philosophy are closely bound up. They are different aspects of the one great enterprise of the human mind. They are both concerned with the understanding of individual facts as illustrations of general principles (p. 179). He defines speculative philosophy as "the endeavour to frame a coherent, logical, necessary system of general ideas in terms of which every element of our experience can be interpreted" (p. 285). Whitehead's whole endeavour is to frame a system of thought which conforms to these canons. We are to-day suffering from the lack of a co-ordinating philosophy of life and it is a pleasure to know that Whitehead's scheme insists on those fundamental beliefs in values which are the only sure stay of the human race.

For Whitehead, as for Plato, God is love more than power. The Dean of St. Paul's in his book on *God and the Astronomers* omits all reference to Whitehead on the ground that he is obscure. Whitehead is undoubtedly difficult and it is unfortunate that Dean Inge has ignored him, for the Dean's views are akin to Whitehead's on religion, for both believe that the greatness of Christianity lies in its illustration of the Platonic truth: "The power of Christianity lies in its revelation in act, of that which Plato divined in theory" (p. 214).

Indian readers will find Whitehead's reference to Gandhi-Irwin truce quite interesting. It is given as an illustration of the practical effectiveness of the religious spirit:

"The other side is that the religious spirit as an effective element in the affairs of men has just (April 1931) obtained one of its most signal triumphs. In India the forces of violence and strife, between rulers and people, between races, between religions, between social grades—forces threatening to overwhelm with violence hundreds of millions of mankind—these forces have for the moment been halted by two men acting with the moral authority of religious conviction, the Mahatma Gandhi and the Viceroy of India (Lord Irwin)."

Part III develops further the views set forth in *Process and Reality* and we see the same logical rigour and metaphysical power which were such characteristic features of the earlier work.

The concluding part deals with those five great qualities of Truth, Beauty, Adventure, Art and Peace, which every society should try to incorporate if it is to be truly civilised. While it is difficult to follow the arguments of this great book, it is not necessary to do so to feel the presence behind it of a refined soul attuned to the highest issues. One noble passage about peace *śânti* may conclude this notice:

"It is a broadening of feeling due to the emergence of some deep metaphysical insight

unverbalised and yet momentous in its co-ordination of values. Its first effect is the removal of the stress of acquisitive feeling arising from the soul's pre-occupation with itself. Thus Peace carries with it a surpassing of personality. There is an inversion of relative values. It is primarily a trust in the efficacy of Beauty. It is a sense that fineness of achievement is as it were a key unlocking treasures that the narrow nature of things would keep remote. There is thus involved a grasp of infinitude, an appeal beyond boundaries."

S. R.

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CATALYTIC OXIDATION OF ORGANIC COMPOUNDS IN THE VAPOUR PHASE. By L. F. Marek and Dorothy A. Hahn. American Chemical Society Monograph No. 61. Pp. 486, 60 figs. (The Chemical Catalog Company, New York.) Price $ 9·00.

This volume provides a surprise for the reader who expects to find an account of the preparation of formaldehyde, phthalic anhydride and other compounds made by catalytic oxidation. It is true these are not omitted, in fact a whole chapter is devoted to each, but the authors have taken the word 'oxidation' in its widest sense so that information is given regarding the hydration of ethylene, the formation of acetylene and diphenyl, and the production of hydrogen from methane, while no less than 62 pages are devoted to the subject of knocking in internal combustion engines.

In the general introduction it is stated that the primary purpose of these monographs is to present certain topics in a readable form; in this purpose the authors can scarcely be said to have succeeded except by those who take pleasure in reading a dictionary. The secondary purpose is to present a well-digested survey. This certainly has been effected, for the book contains a mass of information which is bound to be of value to students in this field; indeed there is so much information that it leaves the reader with a feeling of confusion rather than with a clear view of what has been accomplished. In the preface the authors disarm criticism of their extensive references to patent literature which they admit to be unreliable, by mentioning the scarcity of other sources of information but this does not exonerate them from the duty of sorting out this literature and presenting only those portions which in their opinion appear significant. Of what value to the reader for example is the following? (p. 370) "One patent (for the production of phenol from benzene) has to do with the action of ozone at 390°C. in the presence of an oxygen-occluding substance such as platinum black or platinised asbestos. Pressure is said to exert an important influence and an appropriate form of apparatus is specified and illustrated. This patent is rather broad in its scope and contains fourteen claims covering the oxidation of turpentine and other substances as well." In several cases the long lists of possible catalysts so familiar in the patent literature are quoted *in extenso*. The result is that the really valuable information is buried by unnecessary detail and can only be extracted with considerable difficulty. A great improvement would be effected if only the most important patents were mentioned in the text and the rest consigned to a bibliography with a short abstract of the contents of each. The book contains other unnecessary matter which might well be omitted, for example, table XIX showing the solubility of CO_2 in water and also the description of coal tar and the preparation of naphthalene. It could also do with a great deal of rearrangement; at present it resembles a compilation of library notes under different headings. The action of silver catalysts in the formation of formaldehyde is referred to in two different portions of the chapter; a chain reaction is discussed on p. 211, while on p. 311 under a special heading, chain reactions are explained *ab initio*. The Arrhenius equation is discussed here in almost the same words as on p. 287.

The chapter on 'apparatus' might well be enlarged. At present it bears an air of unreality, the illustrations being merely diagrammatic and conveying little notion of the plant in actual use.

Two misprints, "firebrack" on p. 143 and "Bones" on p. 159 have been noticed, while "to react the formaldehyde with...." and similar expressions jar upon the senses of an English reader; otherwise the book is well and clearly printed as is to be expected in this series.

In spite of these defects it is evident that the authors have taken great pains to amass the material they have presented and the volume forms a most valuable contribution to the literature of the subject. If it could be rearranged and reduced to half its present size it would be even more valuable.

H. E. WATSON.

* * *

CHEMICAL CALCULATIONS: Their Theory and Practice. By A. King, M.Sc., A.R.C.S., D.I.C., and J. S. Anderson, Ph.D., A.R.C.S., D.I.C., both of the Chemistry Department, Imperial College of Science and Technology, London. Pp. x + 181. (Publishers: Messrs. Thomas Murby & Co., London, 1933.) Price *4s. 6d.* net.

This book is designed to provide the material necessary for "the acquisition of a reasonable facility in chemical calculations". The elementary laws and theories on which the calculations are based are explained with several references to original work. The brief descriptions of some of the original experiments help the young student to quickly grasp the fundamental chemical principles on which they are based. The matter treated in Chapter VI "Volumetric Analysis" would have been better placed if it had preceded the chapter on Electrolysis and Ionic Theory. The Chapters I to IV and portions of VI cover the syllabus of the Intermediate Science Examinations of Indian Universities and the rest may be recommended for the under-graduate students preparing for pass course in Indian Universities. A novel and beneficial feature adopted in this book is to provide answers only for alternate problems. The book will serve as a very useful guide for students.

H. S. J.

* * *

THERAPEUTIC AGENTS OF THE QUINOLINE GROUP. By W. F. Von Oettingen. (Chemical Catalog Co., New York. Pp. 301.) Price $ 6·00.

Ever since quinine was recognised as the active principle of cinchona alkaloids and Gerhard demonstrated in 1842 that it contained a quinoline nucleus, the quinoline group of organic compounds have attracted great attention of chemists all over the world in an attempt to substitute quinine by a synthetic drug of equal efficiency against malaria. The efforts in this direction have been generally based on the modern chemo-therapic principles whose applications in spite of their limitations have revolutionised modern medicine.

It is a matter of surprise and disappointment that in spite of a number of important discoveries of drugs through the brilliant applications of these principles within the last half century, the search for a satisfactory quinine substitute has still remained an evasive problem. The attempts have however furnished a series of compounds whose physiological activities are more powerful than those of most other known compounds.

The discovery of compounds like Plasmoquine and Atebrine though not entirely as substitutes of quinine but as important auxiliaries in the treatment of different types of malaria, are of prime importance, which suggest that we may not despair of the possibility of evolving a satisfactory remedy as a quinine substitute entirely.

Again, the study of hydrocupreine and acridine derivatives have yielded interesting results.

The difficulties of progress in this field, while partly due to the inherent complexity of the subject, have been enhanced considerably by a certain looseness of thought and even of experimental technique found widely amongst the investigators. So much so that it is only recently we could say that we have accumulated some information which we may worthily designate as "knowledge".

We have to come to a stage in the investigation of the quinoline compounds when we can with some justification attempt to correlate pharmacological action with their chemical structure. There have been several books following Frankle's "Arzneimittel Synthese" to bring out the relation between chemical constitution and pharmacological action. But a special book on this most important group of organic compounds is a welcome addition. Von Oettingen's book has not appeared too early. The American Chemical Society has done a service to the workers in this field by presenting them with a volume of this nature.

The literature has been brought to our knowledge almost quite up-to-date of publication and includes the most important compounds of therapeutic interest. There are many records to be confirmed, sifted and many gaps to be filled before a number of observations could be evolved into principles of definite value. As the author finally remarks, "it is not infrequently that the physiological problems are attacked by methods which appear to be extremely unphysiologic so that only distorted pictures are observed which may lead to misleading conclusions." This book, we hope, will serve to point out the defects to be remedied, the gaps to be filled and the problems to be solved by more systematic research, and closer co-operation between the pharmacologist and the organic chemist.

This is an American Chemical Society

monograph published by the Chemical Catalogue Co., Inc., and in uniformity with other publications of this series the get-up of the book is excellent. It should find a place in the library of the organic chemist and of the pharmacologist interested in this line.

B. H. K.

* * *

RECENT ADVANCES IN PLANT PHYSIOLOGY. By E. C. Barton-Wright. (J. A. Churchill, 1933.) Price 12*s*. 6*d*.

The long-felt need of a text-book in Plant Physiology embodying the recent work done in the different aspects of plant metabolism is being gradually supplied by the English, American and Russian physiologists. The book under review is a notable attempt to give in a brief space of about 300 pages the summary of the most important aspects of plant physiology. The first edition of this book was published in 1929 and the necessity of issuing the second edition within a period of five years indicates that the book is well received and meets the needs of the students. The second edition of the book shows many improvements and there are many additions and alterations in the subject-matter. The chapter on soils is omitted and a few pages on transpiration of xerophytes is added to the chapter on transpiration. Similar alterations and additions are also made in the chapters on translocation, growth, protein synthesis and respiration. In spite of the numerous changes introduced the principal defects of the first edition are unfortunately not remedied. Firstly, the book still remains unbalanced in the arrangements of the essential materials. Too much emphasis and space are given to certain aspects while other equally important ones are either mentioned briefly or left out of consideration altogether. Secondly, too much prominence is given to the work of English authors. Perhaps the second defect is visible in every text-book written by other writers but in this particular one it is more apparent than in the others. It was expected that the chapter on carbon assimilation would be rewritten giving more readable and coherent account of the whole process; but the writer has not yet seen the necessity of doing it in view of the existing monographs on the subject. One feels that this is no valid reason for not doing it in a text-book principally meant for students. There are many passages which could either be condensed or entirely deleted and the place for other important literature can thus be found.

Apart from these defects and drawbacks the book on the whole makes an indispensable text for students and a valuable guide for teachers as well, as the subject-matter is up-to-date and well presented in many places. Many of the intricate and complex data are very lucidly and intelligibly stated and that perhaps explains the great success that the book has achieved. It is earnestly hoped that when the third edition of the book is to be printed some of the points raised in the review will be considered by the author.

* * *

PLANT ECOLOGY. By Willam Leach, D.Sc. (Methuen & Co., Ltd., London, pp. vi + 104.) Price 3*s*. 6*d*.

Books on Plant Ecology are rather limited. Therefore the present volume, forming one in the series of Methuen's monographs on biological subjects, is a welcome addition for those who are interested in vegetation. The book is designed to give a clear and understandable account of the home life of plants. Plant Ecology does not consist in the mere identification and enumeration of the several plant species in a plant community, but in studying the physiology of the species as influenced by several habitat factors. Thus plant ecology is the science of plant physiology in the natural conditions of plant growth.

A lengthy chapter is devoted to the principles of plant ecology. Plant growth is conditioned by climatic, edaphic, and biotic factors. The various aspects of these factors are considered in sufficient detail, the rôle of soil constituents in determining the distribution of plant communities being discussed at great length. This is not surprising since the present-day tendency is largely directed towards correlating plant growth to several soil factors such as physical and chemical properties, soil water, soil air and organic matter of the soil. The biotic factors manifest themselves through cultivation of the soil, grazing of the cattle and introduction of fire. The last of these is a serious factor because the intensity and frequency of fires largely determine the plant succession, weeds usually spreading after such fires. This is common in the South Indian Plateau.

The methods of practical study are described for the student of vegetation. Following a preliminary reconnoitring survey, a detailed analysis of the plant communities with reference to the climatic and edaphic factors should be made.

Variatious characteristic of plant succession deserve considerable attention. The employment of photographs is a necessary adjunct to such a study. Details are given for practical investigation based on the principles presented earlier.

The vegetation of India is so wide and varied that a systematic ecological study of the several important species distributed over a large area and under a diversity of climatic and habitat factors, is bound to give valuable information for the ecologist.

V. I.

* * *

WORLD ECONOMIC SURVEY, 1932—33. (League of Nations, Geneva, 1933.)

There is the well-known dictum of Alfred Marshall that statistics are the straw out of which economists make bricks, and in economics the great difficulty has been all along to get accurate and unambiguous statistics and interpret them without a bias. Not the least of the several kinds of bias that hamper an economist is the national bias. It is common-place to say that economic problems are assuming a world aspect, and consequently need a world outlook, as opposed to a National outlook. Therefore, whatever else the League of Nations may or may not have done, it is a great service to the progress of mankind that an Economic Intelligent Service is an integral part of the activities of the League of Nations. It is an important centre of scientific investigation of economic problems; not only are valuable data collected and issued in the form of monthly bulletins, year-books, and reviews, but handy summaries are also made available for the benefit of the lay-reader. The volume under review is one such.

The purpose of the volume is two-fold: it does not attempt to diagnose causes or weigh political and economic influences, but merely records and interprets economic developments. Another and an important aim is "to view the whole world, rather than special areas, as the theatre of the developments to be described". Emphasis is laid upon "the international aspects of national economic developments and illustrations are drawn from one country or another merely as they prove accessible or convenient." It is neither possible nor necessary to summarise the chapters, constituting as they themselves do summaries of the more elaborate reports. It is sufficient to state that they "record the damping down of the economic activity in almost every direction", and the even more "serious disorganisation and partial destruction of the delicate machinery of international economic and financial co-operation". The several chapters describe in succession:

1. The Depression of Prices, which continued to include the marked discrepancy between agricultural prices and those of manufactured goods;
2. Diminished Production, with the notable exception of foodstuffs, which showed some increase;
3. A sharp fall in national income, which varied between 20% to 53% from country to country as between 1929-32;
4. Diminished World Trade to about a third of its size in 1929;
5. Fall in Wages and Profits, and Increasing Unemployment;
6. Embarrassment of public finance on account of the inelasticity of expenditure side by side with rapidly diminishing public income.

The Survey is thus mainly a description of "the Contraction of Prices, Production, Wages, Profits, Government Revenues, International Trade and Banking Resources". It records "progressive shrinkage of economic activity in practically every direction". But the concluding sections deal with the World Economic Conference, from which so much was expected, but which proved to be abortive. There is also a brief description of the gigantic American experiment, which, though incomplete, has already furnished the world of students, a remarkable field for observation of laboratory methods. At the same time so diverse are the factors in the economic field that the Survey has to observe that "it is not yet clear how far the improvements and recessions of Industry in the first weeks of the new plan's operations are due to that plan or the result of prior causes. Nor can it be expected that the forces liberated by the plan have yet produced their final or even their most important effects." Both the Economic Conference and the American Plan were preceded by rising prices, increased production and diminished unemployment. As subsequent observations show, these signs of the improved economic health of the world have continued, in spite of the failure of the former, and possibly because of the influence of the latter. It is to be hoped that the concluding sentence of the Survey records a

real state of affairs: "It is probable, however, that apart from speculative advances, there was a more solid core of recovery based upon a definite upward swing of the trade cycle."

N. S. SUBBA RAO.

* * *

MAKERS OF ASTRONOMY. By Hector Macpherson. 1933. Crown 8 vo. pp. 244, with 18 Illustrations. (Oxford University Press.) Price 7*s*. 6*d*.

This book is based on the lectures delivered by the author at the Royal Technical College, Glasgow. Besides giving the lives of prominent astronomers, it gives a popular exposition of modern developments in astronomy not always available to the general reader except in advanced text-books and original papers. The reader is enabled to appreciate the steady and silent work of the votaries of science who have devoted their lives to astronomy in spite of deterring circumstances. Beginning from Copernicus who boldly gave a new orientation to astronomy by dislodging the Ptolemaic system, the book narrates subsequent developments in observational and theoretical astronomy, and concludes with an account of the more important contributions of present-day astronomers. "Themselves creatures of a day, chained to the surface of a dwarf planet moving round a dwarf star which is one of millions in a galaxy likewise one of millions," these astronomers have bid us behold "the height, the depth, the gloom, the glory" of the Infinite. The deep debt of gratitude of the readers to which Hector Macpherson is entitled is in no small measure due to his excellent exposition of the subject and his personal acquaintance with many of the more modern astronomers.

The publishers must be congratulated on the get-up of the book. It must be mentioned that books, such as the one under review, intended to be of a popular character will serve their object better if priced more moderately. The book deserves a place in public and private libraries.

L. S.

HYDRAULICS. By Horace W. King. Pp. 296. (Chapman & Hall, Ltd., London.) Price 16*s*. 6*d*.

The authors have succeeded in presenting the subject in a simple, lucid and highly interesting manner employing only elementary mathematics for the treatment. The book is readable both by University students and practising Engineers.

It covers the syllabus of a University Course and is very suitable, particularly as a text-book for Civil Engineering students working for an Engineering Degree. At the end of every chapter there are many exercises which add to the usefulness of the book, but their value would have been greatly enhanced, if a larger number of representative exercises had been worked out and included in the body of the book.

The chapter on weirs and dams covers a wide field and the discussion of a number of empirical formulæ with extracts from weir experiments, as well as of the coefficients and formulæ arrived at by various experimenters greatly add to the value of the book. Principles of fluid flow are clearly explained and the method of evaluating coefficients of friction in pipes for all fluids is certainly a valuable addition.

Flow in channels is exhaustively treated and the comparison of the Kutter's and the Manning's formulæ showing the greater simplicity and reliability of the latter as compared to the former especially for flat slopes is instructive. Non-uniform flow in channels and flow under unusual circumstances such as accelerated flow, Hydraulic jumps, translatory waves, etc., are dealt with in a simple and interesting manner.

The chapter on Hydro-dynamics is a welcome addition to the book, but a chapter or two on hydraulic machinery would perhaps make it complete in every respect.

The treatment of the subject is exceedingly good on the whole, for which the authors deserve warm praise.

V. G.

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Science and the Pace of Life.

IN an interview with a press correspondent at Bremen before he went on board the liner, 'Oakland', for San Francisco, Professor Albert Einstein is reported to have said that the present pace of life was too fast for the man-in-the-street even to catch the newspaper headlines and it was imperative that we slowed down. "A few years ago people had a chance to sit down and think. It could not be helped if some did not make use of the opportunity, but now no one is in a position to stop and think even if he desires to do so. We are moving too fast to allow a general understanding of science. The public is not much interested in it nor does it understand science. It is paradoxical, but apparently true, that the very instruments of science, instead of being devoted to help common men to a greater understanding of reality are doing just the opposite and are only succeeding in befuddling things even more. Scientific technique is growing so fast that it must soon slow down to permit the ordinary man to catch up."

To a casual reader of these sentences, if they have been reported correctly, they might seem to contain a severe indictment of the attitude of scientists towards the general public, and might even be understood to convey the impression that Professor Einstein thought that the progress of scientific investigations would not lose much if they were suspended for such time at least as would enable the common people to assimilate their great advances. It is perfectly true that the rush of modern life in Europe and America is far too tumultuous and excited to permit the man-in-the-street to stop and think of what is going on around him but science may not be the only contributory cause of this senseless impetuosity. We seem to forget that 'the world has not and never had any assured hope of progress and perfectibility' and neither acts of Parliament nor achievements of scientists can coerce them. The restlessness and discontent of the present age have their roots in social and economic causes and it is doubtful if the progress of science assisted in their acceleration. Most men are the victims of half-knowledge which is worse than honest ignorance, and being products of a bad system of education, are unable "to turn the light of knowledge on

their own hearts while doing their own work." The present age has ceased to regard leisure and tranquillity as indispensable for adorning human environment and has placed implicit faith in wealth as the chief necessity for the embellishment of life.

This change in the scale of human values must account for the feverish pleasures and restless frivolities connoted by the "pace of life" to which Professor Einstein refers. Human happiness is conceived as centering in material comforts and the doctrine which assigns a subordinate position to worldly goods has become infructuous. The suggestion that greed is misery and its absence, happiness will have no meaning to the age which worships the golden calf. The thriftless yearning for money accounts for the mad rush of life and the unequal distribution of wealth, for much of the world's wickedness. There have been great civilizations in the past history of the world in which the ostentatious display of wealth formed the most conspicuous feature of the national pomp and pageantry, but history does not record that the people were consumed by such sinister passions as disfigure modern civilization. If in the days of the Mauryan dynasty and under Gupta administration unlocked doors did not excite the cupidity of the people, a great atavistic change must have since come over the human mind, a certain section of which laughs at locks, safes and science. Under the influence of growing industrialism, the concentration of population in urban areas, the stress of economic competition and the general prevalence of squalor, crime and poverty, the human mind has been insidiously estranged from spirituality which has been for ages its sheet anchor. The principal defect of modern civilization is the total absence of the fear of the Lord whose place is taken by Scotland Yard and the magistrate. The criminal, therefore, embarks on his private enterprise fairly convinced that he can elude human eyes and all other forms of anti-social practices are traceable to the same cause.

The invention of rapidly moving vehicles has brought the continents nearer each other, promoted commerce, stirred the instincts to accumulate large wealth and has also spread disease and has enabled international gangsters to set up *alibis*. The quieter and more normal aspects of life have nearly ceased to interest us and the growing tendency for the sensational and the abnormal is reflected in our public tastes, amusements, fashions and literature. This morbid craving for stupefying thrills which is becoming general, is symptomatic of the degenerative process of the human mind which has missed the essence of absolute life, its hopes, its beauties and its ideals. The conflict between religion and science which occupied the greater part of the nineteenth century, has been wrongly assumed to have proved that the ideals of the former are thrown into the unknown future, thus paving the way for the purely materialistic conception of life. The attempt to interpret the world in mechanical and quantitative terms has led to the application of these principles to human life which was conceived to be an automaton and which, escaping from the stern discipline imposed by religious ideals, seeks its pleasures limited rather by the power of its enjoyment than by the apprehension of their effects on its intellectual, moral and spiritual endowment. The reason for the human mind's breaking away from religious doctrine is partly due to its non-recognition of man as an organic factor of the world and no theory which separates the two can satisfy philosophy and science. We are reaping the fruits of the supposed senseless antagonism between science and religion and its manifestations must necessarily perplex thinking minds. Instead of being mutually antagonistic, they represent the two modes of approach to the same problem, *viz.*, life, in the investigation of which both are handicapped by the limitations of human intelligence and the defectiveness of the instruments of study. We are more conscious of our life than all the facts and evidences against 'life' as a spiritual entity and this very imminence of 'conscious life' baffles a detailed conception of its essence. The limitations of science are not different from those of the human mind and their continuance must indicate that the intuitive perceptions on which religion bases its doctrines of right and wrong, are quite as safe a guide as any that can be wished for. The promptings of the heart are far more true than the ratiocinations of the head.

The pace of life is not set by science alone though its discoveries on the practical side may have given it an impetus. Science is occupied with the investigations of the properties of matter, their causal relations and their behaviour under certain induced and normal conditions but its office does not cease with the discoveries which it

makes. It has a higher purpose and nobler destiny. Most of these discoveries have a practical application which may be directed to the improvement of life as well as its destruction, but science does not lead the way to either. The prostitution of the gifts of science is the business of the commercial and industrial syndicates and of the Government. It is here where the scientific results are applied to the practical problems of life that the pace commences, stimulated largely by economic competition, trade jealousy, fat dividends and capitalization of industry. The hunting after money like every species of hunt, is intoxicating and in its mad pursuit, the graces and beauties of life are ruthlessly sacrificed for those goods which all religions condemn as the parents of every vice and wickedness. The gold frenzy is at its critical point just now and when it subsides religion and science will have to step in to increase the wealth of the world by substituting new values in regard to human happiness which is at present treated as synonymous with material comfort. It is when we have reintroduced fear and admiration in our town life which is marred by social unrest, when we have humanised the commercial and industrial organizations which are riddled by maladjustments, when the rural population is enlightened enough to become intelligent participators in the gifts of learning and in civic administration that hopes may be entertained of the co-ordinated progress of the nation, with sufficient leisure and tranquillity to devote time and talents to the enrichment of their home and environment.

No one can be more vividly conscious of the limitations of science than he who has lived it, and its function is "no more to save our bodies than it is to save our souls". It seeks to uncover the veil of nature and deals with her facts and phenomena disclosing new worlds of thought, reality, laws and history of the visible universe. With the more technical parts of science, the general public can have very little to do, but it ought to be possible for those who have attained a reasonably high degree of education to become acquainted with the general advances of those departments of knowledge in which they are most interested or in which they have received their earlier training. To democratise science need not necessarily involve its degradation. At present the whole firmament of public life is dark, illumined here and there by a few stars of the first magnitude whose glory is scarcely discernible in the immense general gloom of the sky. What Professor Einstein wishes is a widespread diffusion of light throughout this vast area, each body in it having the power of self-luminescence. It would be too narrow a view to take that the task of science begins and ends with research; for if the knowledge of science is good then it must be good for something and for somebody. It is perfectly legitimate for the scientist to emerge from the laboratory and give the people who care, an account of the joys and pleasures and the difficulties and trials in the prosecution of his studies and make them feel the same thrills, and participate in the cultural benefits which may have accrued to the investigator himself. All the agencies that are impressed in this task, *viz.*, the Universities, the learned societies, the scientific associations and congresses and the press, have established wide channels of communicating knowledge to the general public, but their efforts are obscured by causes over which science has little control. We have to cure the gold fever before science can come to its own.

In India the task is far harder. Education has scarcely touched the outer fringe of the vast population. Those who have received the benefits of education are interested in matters and problems far removed from science. The younger generation is concerned more with the task of obtaining a livelihood than with extra courses of studies for the cultivation of mind. Those that have worldly goods, leisure and a fair measure of tranquillity are engrossed with activities naturally befitting their station in life. To the businessmen science is a superfluity. The Indian universities are nevertheless engaged in overcoming the inertia and in improving the pace of life in the right direction; but it will certainly take a long time for an exotic knowledge conveyed best in the foreign language to permeate and enlighten the whole of the Indian population. Whether it be in India or in any country, public life when freed from the tyranny of gold will instinctively seek knowledge, create leisure for the enjoyment of the beauties of art and literature, acquire power to visualise the higher ideals and the ambitions of a larger life than the one circumscribed by the narrow limits of industries, commerce and lop-sided progress,

Hyperfine Structure of Elements in Mercury Arc—I.

NUCLEAR MOMENT OF ZINC 67.

By Prof. B. Venkatesachar, M.A., F.Inst.P., and L. Sibaiya, B.Sc., A.Inst.P.

THE mass-spectrograph analysis of the isotopic constitution of zinc by Aston (*P.R.S.*, **130**, 302, 1931) has revealed the existence of seven isotopes with relative abundance as given below:

Mass Number	64	65	66	67	68	69	70
Percentage abundance	48.0	2.5	25.9	5.3	17.1	0.85	0.38

Recently, Bainbridge (*Phys. Rev.*, **39**, 848, 1932) has shown that the ions of mass numbers 65 and 69 measured by Aston were hydrides of Zn 64 and Zn 68. Bainbridge's densitometer curve of the mass-spectrogram seems to indicate that the percentage abundance of Zn 67 is considerably greater than Aston's estimate. It can, however, be safely assumed that this odd isotope has an abundance not exceeding 10%. If as in the case of cadmium the odd isotopes give rise to the satellites, in zinc they must be expected to be far less intense relative to the main lines than in cadmium or mercury, where the relative abundance of the odd isotopes is 23% and 30% respectively. The small percentage of the odd isotope 67 along with its comparatively low atomic weight renders the satellites of zinc lines faint and fuzzy. The failure of the early observers to obtain hyperfine structure in zinc lines is to be traced to this cause. Schüler and Brück (*Z.P.*, **56**, 291, 1929) finding the lines simple concluded that the result was due to the absence of odd isotopes, Zn 67 being then unknown. Snoek and Bouma (*Z.P.*, **38**, 368, 1926), Wali Mohammed (*P.M.*, p. 1112, 1928) and McLennan and Allin (*P.M.*, **8**, 515, 1929) had even earlier found the lines to be single. More recently Schüler and Keyston (*Z.P.*, **68**, 174, 1931) and Murakawa (*Z.P.*, **72**, 793, 1931) have independently come to the conclusion that the nuclei of all the isotopes of zinc have zero moment based on the fact that the lines show no structure. Hence in this re-examination of the zinc lines it was thought necessary to devise an experimental arrangement in which the satellites are relatively enhanced without introducing complications arising from self-reversal.

The source used is a long column mercury arc, more than 30 cms. long, with a current density of about 1.5 amperes per sq. cm., through which a slow stream of zinc vapour is continuously passed. The apparatus in Fig. 1 is made of Pyrex glass with a detachable fused quartz window W at one end for observation. When the necessary vacuum is reached, the main arc between the mercury cathode K and the tungsten anode B is started, and a few minutes later the long column arc between K and A lights up. The main arc is then switched off. The zinc in the side tube Z is then gradually heated electrically and a stream of zinc vapour is passed through the long arc. The axial radiation is first analysed by a Hilger E_1 spectrograph with a glass train and each line of the zinc triplet $4^3P_{012}—5^3S_1$ is separately examined by three Lummer plates, all of them definitely known to give ghost-free patterns. Assuming that the ratio $\frac{\text{emission}}{\text{absorption}}$ is the same for all the components of a line, it follows that in a long column the weak satellites, suffering little absorption relative to the main line, are enhanced. An examination of the photographs of the triplet patterns reveals indubitably the existence of hyperfine structure in zinc, but because of the faintness and diffuse character of the satellites the following values require further confirmation:—

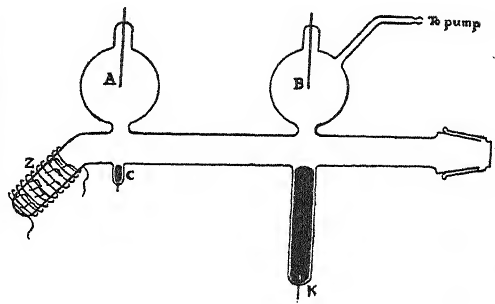


Fig. 1.
Diagram of Source.

Line		Structure $\Delta\nu$ in cm.$^{-1}$ (Int.)
4810	$4^3P_2-5^3S_1$	$+0{\cdot}319$ (1)
		$+0{\cdot}147$ (2)
		$0{\cdot}000$ (10)
		$-0{\cdot}177$ ($1\frac{1}{2}$)
		$-0{\cdot}315$ (0)

Line		Structure $\Delta\nu$ in cm.$^{-1}$ (Int.)
4722	$4^3P_1 - 5^3S_1$	$+0\cdot312$ (1)
		$+0\cdot131$ (2)
		$0\cdot000$ (10)
		$-0\cdot153$ ($\frac{3}{4}$)
		$-0\cdot288$ (0)
		$-0\cdot365$ ($\frac{3}{4}$)
4680	$4^3P_0 - 5^3S_1$	$+0\cdot271$ (0)
		$+0\cdot087$ (1)
		$0\cdot000$ (10)
		$-0\cdot155$ (1)
		$-0\cdot409$ ($\frac{1}{2}$)

Figure 2 gives the densitometer curve of Zn I 4680 Å $4^3P_0 - 5^3S_1$ kindly taken by

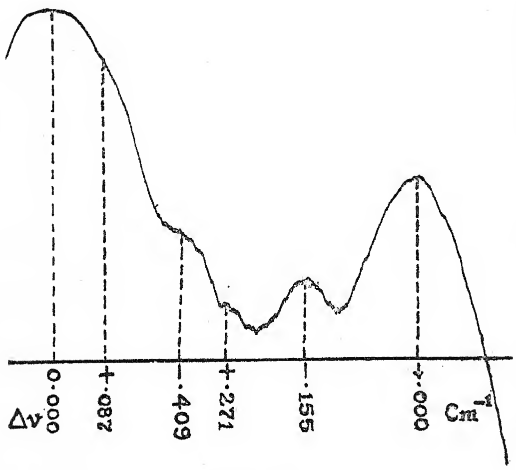


Fig. 2.

Microphotogram of the Lummer plate pattern of the Zn I 4680 Å.

Messrs. Carl Zeiss and shows clearly all the satellites of this line. The observed structures for these lines indicate that the nuclear spin moment of the zinc isotope Zn 67 is most probably $\frac{1}{2}\,\frac{h}{2\pi}$ and the hyperfine levels are all regular and not inverted as in the case of cadmium. Based on these assumptions a tentative scheme of levels proposed is indicated in Fig. 3. This accounts for most of the observed satellites, only a few relatively fainter ones remaining unexplained. The main lines as in the case of cadmium have to be ascribed to the even isotopes of zinc. The observed hyperfine structure cannot be the result of the shift due to the several even isotopes, as the relative intensities of the components bear no resemblance to the relative abundance of the even isotopes.

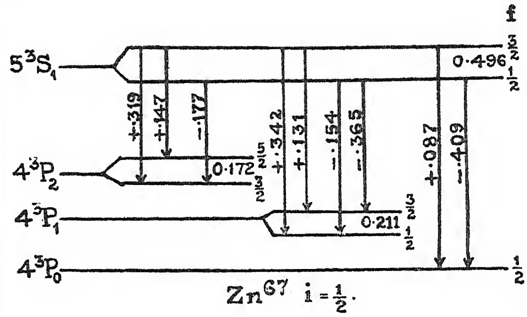


Fig. 3.

The fact that other investigators have almost invariably reported the absence of structure in the prominent arc lines of zinc raises the question whether in the present case, the large admixture of mercury vapour has not any influence in bringing up the satellites. We raise this question because in the case of cadmium under similar conditions of excitation we have observed additional satellites which do not work into the Schüler scheme. The same is the case with the line 5351 Å of Tl I. It must, however, be admitted that one has to establish beyond doubt that the presence of a foreign substance such as mercury is a necessary condition for the appearance of these additional satellites. There is always the possibility that these faint satellites may be caused by isotopes present in such small relative abundance that the mass-spectrograph has not been able to reveal them. Or on the other hand if the conditions of excitation, the presence of a foreign vapour and other factors influence the structure so far as the faint satellites are concerned, we shall have to trace their occurrence to a cause hitherto not considered. For on the hypothesis of a nuclear spin alone, it becomes increasingly difficult to understand why a change in the conditions of excitation should bring out new satellites. The insufficiency of the present theory to account for the hyperfine structure phenomenon in all its aspects has, however, been pointed out by other investigators.

The Problem of the Lantana.

By A. V. Varadaraja Iyengar, M.A., M.Sc., A.I.C., A.I.I.Sc.,

Department of Biochemistry, Indian Institute of Science, Bangalore.

IT seems almost incredible that a small ornamental hedge shrub introduced into India about a century ago should have developed into pest proportions and overrun millions of acres of cultivable land and forest areas in almost every province of this country! Yet such is indeed the case: the menace of the lantana is one of the most serious problems of India to-day and unless a quick and cheap method of controlling its spread is soon discovered, the rapid invasion of this naturalized exotic will do incalculable harm to the preservation and progress of agriculture and forestry in the country.

Lantana Camara Linn (*Syn. L. aculeata* Linn) belongs to the natural order, *Verbenaceae* and would appear to have been originally introduced into this country from Mexico. It is a thorny shrub with re-curved prickles on the stems and branches, leaves possessing a strong and pleasant odour and flowers varying in colour from yellow to crimson. The fruits, which are formed in large numbers practically all round the year, resemble black drupes and are readily consumed by birds and animals, which disseminate the seeds through their droppings. Under favourable conditions the shrub forms a dense, impenetrable growth often reaching a height of over ten feet, the thorny branches forming a network resulting in a closed canopy. The plant flourishes under varying soil and climatic conditions, in regions of high and low rainfall (200—30 inches per annum), in rich as well as poor soil and in low-lying regions as well as on hill slopes upto a height of about 4,500 ft. above sea-level. Its growth is most intense among the uncultivated lands and scrub-type jungles of the Deccan plateau, parts of the Vindhyas, Chota Nagpur and Assam, while in the deltaic regions, particularly those on the East Coast, it is either sparsely distributed or does not occur at all.

The lantana is, normally, a light-loving plant but it can also grow under moderate shade. It withstands drought, is highly tenacious of life and regenerates quickly after being cut, trampled or burnt by fire. The plant burns readily even in the green thus facilitating the spread of forest fires and consequent destruction of more valuable species. After the fire the lantana is the first to recover; it comes up with a denser growth than ever before and thus smothers out other species that may regenerate more tardily. It propagates readily from stumps or cuttings but in the field or jungle the regeneration is generally from seeds.

During recent years the spread of lantana has been enormous and rapid. About 50 years ago, the shrub was found in isolated patches in uncultivated and fallow lands but now it has spread throughout India and Burma, particularly in the Deccan plateau, where it encroaches even on cultivated lands with the result that its eradication has now become one of the most important and immediate problems of the farmer. Unfortunately no systematic record of the spread of lantana in different parts of the country is available but the following data relating to four forest ranges in North Salem, Madras Presidency, would illustrate the position:—

Range	Area under lantana in acres 1917	1931	Spread during the interval
Dharmapuri	Nil	20,844	20,844
Anchetti	45	37,524	37,479
Denkanikota West	1,472	45,806	44,334
Denkanikota East	2,005	35,090	33,085

In the district under reference the area under lantana has increased from about 3 to 42 per cent of the total forest lands within a short period of fourteen years. Judging from the present rate it is not improbable that almost the entire area of not only North Salem but also the remaining part of the Deccan plateau will soon be overrun by this highly aggressive shrub.

Further instances of the dangers arising from the spread of lantana are not wanting. Culturable wastes and fallow lands are rendered unworkable: the soil is depleted of its nutrition and subsequent crops almost invariably fail. The erstwhile grazing grounds are now covered up with lantana which, in addition to suppressing the growth of grass, also prevents the cattle and sheep from gaining access to the little that may be enclosed within. In the deciduous type of forests lantana is chiefly responsible for periodical outbursts of forest fire while in the semi-evergreens it is steadily ousting the

more valuable species, causing degeneration from the original climax type. Lantana is a bad host for sandal because it fails the latter in seasons of drought and subjects it to excessive shade in others. Judging from the high incidence of sandal spike in lantana areas, the shrub would appear to be, in some way, connected with the spread of that dreaded disease. In many parts of the country lantana is found to harbour injurious insects including malarial mosquitoes so that it becomes a source of danger to other plant life and a menace to public health.

The existence of lantana is not, however, an unmixed evil: it has also got some valuable properties which have either not been fully understood or adequately utilized. In addition to making an ornamental hedge plant, its ability to thrive on some of the poorest soils like gravel or hard laterite facilitates the opening up of areas which are inhospitable to most other plant species and which would otherwise become rocky and barren. The plant itself contains several valuable ingredients, some of which are being utilized while the others are still awaiting proper application. The leaves and flowers contain essential oils which were studied by Kanga (*Jour. Indian Inst. Sci.*, **1**, 93, 1914-18) and later by Moudgil and his co-workers (*Perf. and Ess. Oil Rec.*, **13**, 173, 1922; *ibid.*, **16**, 9, 1925). The oils are yellow in colour with pleasant and somewhat powerful odour: they are being distilled by some firms but their uses would still appear to be obscure. Edel Behram investigated the possibility of using the leaves as substitutes for tea. He detected the presence of a large number of enzymes including a powerful oxidase corresponding to that present in tea. He fermented the leaves and obtained a product which though resembling tea in appearance did not yield a beverage of the same quality (*Jour. Indian Inst. Sci.*, **2**, 195, 1918-20). The above study was essentially a preliminary one and requires repetition under standard factory conditions. De, Ganesh Rao and others have shown that the composition of different parts of the lantana plant, particularly the leaves, would point to their being suitable for the manufacture of synthetic organic manures (*Agri. Jour. India*, **25**, 143, 1930): the more recent observations of Subrahmanyan and Jagannatha Rao show that composts prepared out of lantana contain a fairly high percentage of phosphoric acid, a constituent which is sadly wanting in most Indian soils (*Jour. Indian Inst. Sci.*, **15A**, 89, 1932). The possibility of using the twigs for the generation of heat and power, the manufacture of mineral fertilizers from the residual ash, the products of destructive distillation of the whole or different parts, the application of the residual charcoal for adsorptive or clarifying operations in arts and manufacture, the disinfective and insecticidal properties of the oils and related preparations, the uses of the variegated pigments present in abundance in the flowers—these and related problems are still awaiting solution.

Although the aggressive and pestilential nature of lantana would provide a strong argument for its eradication, yet the few good qualities which it is known to possess and the inadequacy of our knowledge regarding the others would justify its retention provided it does not endanger the life of other valuable plant species in the forest or on the field. The problem would, therefore, resolve itself into one of controlling the distribution and spread of lantana.

In recent years, several attempts have been made, particularly in South India, to check the spread of lantana but, unfortunately, without much success. The problem engaged the attention of the Coorg Government as early as 1912. Tireman drew pertinent attention to the evil effects of lantana on other forest species, particularly sandal, and proposed an elaborate scheme for its elimination from that province. His method consisted in stumping the plants in February or March and removing the cut material away from the stumps and burning it. The stumps were to be subsequently pulled out in the rainy season when the ground is soft. Frequent uprootal in the above-mentioned manner for at least four years were considered necessary to ensure the success of this mechanical operation (*Indian Forester*, **42**, 385, 1916). Tireman's scheme involved the clearing up of 63,000 acres in the course of 12 years at a total cost of $4\frac{1}{2}$ lakhs of rupees, but unfortunately it was not adopted. A special legislation known as "The Coorg Noxious Weeds Regulation" was introduced in 1914, but no action seems to have been taken to prevent the natural spread of lantana.

Insect control of lantana is claimed to have been successful in the Hawaii islands where the agromyzid fly feeds on the immature seeds and thus prevents the

regeneration of the plant. With a view to determining whether similar methods of biological control would be possible in India, the Government deputed Rao Bahadur Y. Ramachandra Rao in 1916 to study the insect relations of lantana and to suggest means of checking its spread. The results of the investigations are embodied in a long and useful report (*Dept. Agri. India, Memoirs Ent. Series*, **5**, No. 6, 1920) wherein the author has listed the various species of insects visiting lantana. No evidence could, however, be found to suggest that any of the indigenous species is capable of keeping the shrub sufficiently under check. The author suggested, therefore, that the foreign fly should be imported into India. The proposal did not, however, meet with general approval: in the preface to the Memoir under reference, Mr. Bainbridge Fletcher, the Imperial Entomologist, viewed with apprehension the possibility of the agromyzid fly proving a menace to the other members of the order *Verbenaceae* and, in particular, to teak (*Tectona grandis*) in which case the loss will be irreparable. Some attempts were still made to introduce the agromyzid fly into India. Dr. Kunhi Kannan obtained a few insects with great difficulty and released them in Bangalore: but though he was satisfied that the insects did no harm to teak, he could not yet get them to 'catch' on lantana with the result that they all escaped and could not be subsequently traced, despite careful search! (*Agri. J. India*, **19**, 504, 1924.) Even in Hawaii the agromyzid fly has no very marked effect on lantana: the area under that shrub has always remained small so that it is difficult to define the possible efficacy of introducing the insect into India on a large scale. The insect would not appear to be as specific in its action on lantana as is the cochineal insect on prickly pear so that the possibility of effectively controlling the spread of lantana by the introduction of that seed fly would appear to be rather remote.

Cultural control of lantana is a promising line of enquiry, but no systematic attempt in this direction has so far been made. There is evidence to show that certain soil conditions as also the floristic make up of certain regions are highly effective in checking the spread of lantana. Even in areas like North Salem where lantana abounds there are numerous little patches where the shrub either makes poor growth or does not appear at all. In certain localities where the soil contains a high percentage of kaolin or certain other light, silicious earths, lantana is generally absent while other species flourish. It has already been stated that lantana does not thrive under dense cover and that heavy foliaged species of the high forest type generally keep out the incursion of this shrub. As an instance of this it may be mentioned that in the Siddapuram R.F., in North Salem, lantana does not grow under the heavy shade of the evergreen shola species and even in places where it has gained entrance the shrub invariably exhibits a weak growth. It is true that the introduction of *Ficus elastica* or castor did not prevent the spread of lantana in certain parts of Madras, but further systematic study might reveal the presence of more powerful species that would not only check the spread of lantana but would also help to eliminate it from other areas.

The use of chemicals for the eradication of undesirable plants is well known and is extensively adopted in America. There are a number of cheap inorganic and organic chemicals which are deadly in their action on all forms of plant-life: there are others which are selective or specific in their action. It is not improbable that a judicious application of one or both of the above types of compounds would be helpful in either keeping down lantana or eliminating it altogether. To be efficacious, the chemical must be easy of application and possess high penetrative power reaching the farthermost ends of the plant; it must be highly toxic even at low concentrations and effective irrespective of season. A thorough knowledge of the physiology of the plant is also essential to gain an insight into the nature of its response to various treatments. An investigation into the above and related aspects of the problem has been undertaken by the author in co-operation with the Madras Forest Department. Various observations of interest have already been made both in the laboratory and on the field among which particular mention may be made of the fact that chlorates and arsenicals are highly effective in killing lantana. A study of the various methods of application is also under way.

Much more yet remains to be done. The extent of spread of lantana in different provinces, the rate and manner of its progress, its effect on other forms of vegetation and its relation to plant pests and carriers of human disease require investigation

in detail. The precise nature of the soil conditions that check the spread of lantana has yet to be ascertained. A systematic survey of the ecology of that shrub has to be made in different parts of the country, particular attention being paid to areas where other forms of vegetations have steadily dominated over lantana, so that the observations with regard to the flora as well as the fauna of such localities may provide the necessary clues to similar control in other places as well. The introduction of the foreign fly does not appear to be a promising line of attack, but in view of the incomplete evidence provided by the previous work, some further trials may be carried out with that insect. In the laboratory a great deal of systematic work is still awaiting to be investigated. Some useful beginnings have no doubt been made at the Indian Institute of Science, but more intensive work has still to be carried out, particularly with regard to the conversion of the different parts of the shrub into synthetic organic manure for use in areas where other forms of vegetation are scarce. Attention should also be paid to the economic combustion of the plant for generation of energy, the utilization of the different products of distillation in arts and manufacture, and the exploitation of the ferments, oils and other constituents already known to be present in the plant. The observations on chemical control have to be repeated in various provinces and in different seasons and the conditions standardized for extended adoption of the technique. The above and related problems are of considerable practical importance and it is earnestly hoped that they will soon engage the attention of the Imperial Council of Agricultural Research, the Forest Departments of the different provinces and the scientific laboratories in different parts of the country.

The author desires to express his thanks to Dr. V. Subrahmanyan for many helpful suggestions, and to Messrs. A. M. C. Littlewood and S. Rangaswamy for co-operation in the research and much valuable information in connection with the occurrence and spread of lantana.

Obituary.

Lt.-Col. John Stephenson, I.M.S., C.I.E., F.R.S.

THE sad news of the sudden death of Lt-Col. John Stephenson, C.I.E., M.B., Ch.B., F.R.C.S., D.Sc., F.R.S., F.R.S.E., I.M.S. (retd.), on 2nd February 1933, came as a great shock to his old pupils and friends throughout India.

Colonel Stephenson was born in 1871 at Padiham, Lancashire, and was educated at the Burnley Grammar School and the University of Manchester. In Manchester he had a very distinguished career in zoology and medicine. After qualifying as a doctor Stephenson acted for a time as the House Surgeon in the Manchester Royal Infirmary and the London Hospital for the diseases of the chest till in 1895 he passed the competitive examination for the Indian Medical Service. For the first five years of his service in India he was on military duty and saw active service with the North-West Frontier Expedition of 1897. He was posted as a medical officer on plague duty in the Punjab in 1900, and up to 1906 served as a Civil Surgeon in Rawalpindi, Gujrat, Ambala and other places. Early in 1906 he went on leave and passed the Fellowship examination of the Royal College of Surgeons, London, with a view to appointment as Professor of Surgery in the Lahore Medical College. Fortunately for the study of zoology in India, the recent experiment of the transfer of the teaching of pure science subjects, like botany and zoology, from the Medical College to the Government College, Lahore, had not, for want of properly qualified teachers, proved the success that its initiators had hoped. The then Lieutenant-Governor of the Punjab, Sir Denzil Ibbetson, who was a personal friend of Colonel Stephenson, knew that Stephenson had studied zoology in Manchester under the famous professor A. Milnes Marshall, and knowing Stephenson's capacity as an organiser and worker, he prevailed on him to undertake the duties of the recently created professorship of biology in the Government College, Lahore. He held this position till 1912 when, in addition to being the Professor of zoology, he was appointed Principal of the Government College, Lahore. He retired from service in India in September 1921, and went over to Edinburgh where he was appointed Lecturer in zoology in the University. In November 1929 he left Edinburgh for London and till shortly before his death he used to carry on zoological researches in the British Museum of Natural History as an unofficial worker.

On his appointment as Professor of biology in 1906 Stephenson, who had been out of touch with zoology for nearly eleven years, started earnestly to brush up his knowledge of the subject and bring it up-to-date. Though he had a fairly good teaching museum at his disposal there was neither a properly equipped laboratory nor any library worth the name in the Government College, Lahore. He was, however, able to get together before long a first-rate teaching museum, a very good working library and by 1914 had succeeded in having a new biological laboratory built for the institution in which he was working. As a result of his labours, zoological instruction in Lahore attained a very high standard in a few years and he was able to found a very productive school of zoology in the Government College. Several students from his laboratory, in whom he instilled the faculty of critical work and careful investigation from the very beginning, are now holding influential zoological positions throughout the country, and it was solely due to his initiative and interest that a really flourishing school of zoological research was established in Lahore. His tenure of office was marked by conspicuous success as a teacher, while his administrative qualities were responsible for making the institution under his charge into a really

first-rate place of instruction. He also took a very active interest in the affairs of the Punjab University and in addition to being the Dean of the Faculty of Science, he acted during the last year of his stay in India as the Vice-Chancellor of the Punjab University.

Stephenson was not content with teaching zoology only, but started research work in zoology soon after his appointment in Lahore and by 1909 had produced a thesis which earned for him the degree of Doctor of Science of the London University. His researches from the very beginning were concentrated on the Oligochætes, and from 1907 onwards till shortly before his death he published numerous papers on Oligochætes of India and other areas. The results of his systematic work on Indian Oligochætes for over 16 years were collated in his volume on the Oligochætes in the "Fauna of British India" series and since that date he was recognized as one of the two chief authorities on this group of worms. In 1929 he completed the masterly morphological and systematic monograph on the Oligochætes which was published in 1930 by the Clarendon Press, Oxford. In addition to the systematic studies on the Oligochætes he carried out researches of outstanding character on the intestinal respiration of Oligochætes and worms in general, and published several very important morphological papers on the structure of these worms in the "Transactions of the Royal Society of Edinburgh" and the "Proceedings of the Royal Society of London". His monograph on the Oligochætes clearly indicates his extensive knowledge of the structure and classification of the Oligochætes and a very thorough acquaintance with the literature on the subject. In addition he dealt in detail with such important questions as convergence, the polyphyletic origin of the various genera and families and the geographical distribution of earthworms. In connection with the distribution of these worms he discussed in detail the former existence of an Antarctic continent and land-bridges between India and Australia on the one hand and the Peninsular India and Africa on the other. He also published a very valuable account of the Nemertines of the River Clyde in the "Transactions of the Royal Society of Edinburgh".

Stephenson was a great linguist and all his spare time was devoted to the study of early Persian authors. He published a collated edition of all the known manuscripts of *Hadiqat-ul-Haqiqat* in the "Bibliotheca Indica" published by the Asiatic Society of Bengal together with an English translation and annotations of the *Muzhat-ul-Qulub* in the publications of the Royal Asiatic Society of London.

For his work as an administrator and teacher Colonel Stephenson was awarded the title of C.I.E. in June 1919. His contributions to the advancement of knowledge were recognized by the award in 1920 of the Keith Memorial Medal of the Royal Society of Edinburgh and of the Barklay Memorial Medal of the Asiatic Society of Bengal in 1925. He was Fellow of the Royal Society of Edinburgh, and the Asiatic Society of Bengal, and received the blue ribbon of science on his election as a Fellow of the Royal Society of London in 1930. He was appointed Editor of the "Fauna of British India" series in May 1928 in succession to the late Sir Arthur Shipley and since 1931 he worked as the Zoological Secretary of the Linnean Society of London.

Colonel Stephenson was a very brilliant teacher and those who had the privilege of attending his lectures will never forget the care and pains he took in making the subject of lectures really instructive and interesting to his students. He was a sincere and loyal friend and all his friends will miss him for his sound judgment and ever-ready help in all matters relating to education and more particularly to the advancement of zoology in India and later in Great Britain. His extensive circle of friends feel his untimely death as a personal bereavement and extend their sincere and heart-felt condolence to Mrs. Stephenson in her irreparable loss.

B. P.

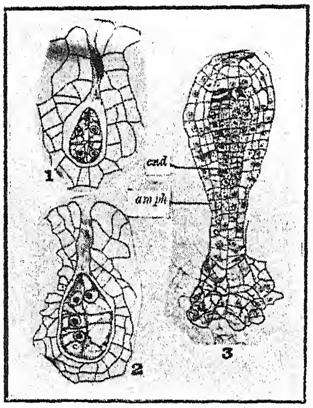
Letters to the Editor.

The Origin of the Archesporium in *Notothylas levieri* Schiff. MS.

VARIOUS authors have proposed to separate the Anthocerotales from the liverworts and place them in a class co-ordinate with the Hepaticæ. One of the main arguments advanced in support of this view has been that while in all the other liverworts the archesporium arises from the endothecium, in the Anthocerotales it comes from the amphithecium.

My examination of *N. levieri*, a common Himalayan liverwort, shows that this distinction can no longer be maintained and favours the retention of the Anthocerotales within the Hepaticæ.

The early stages in the embryogeny of *N. levieri* conform to the usual anthocerotalean type (Figs. 1, 2), but a radical difference is seen in the origin of the archesporium. Unlike the condition observed in the other anthocerotales, the archesporium here originates from the entire endothecium (end.), while the amphithecium (amph.) forms only the wall (Fig. 3).



1 and 2. × Ca 720.
3. × Ca 500.

My conclusion based on the observations of the early as well as the older stages of development of the sporogonium differs from that of Kashyap and Dutt[1] on the same species, which is based on the study of development from the meristematic zone at the base of the capsule and which is to the effect that the archesporium arises from the endothecium as well as the inner layer of the amphithecium though they do not give any figures.

A very careful study has been made by me to decide this point and an examination of numerous preparations which contain embryos at practically all the critical stages of development leaves no doubt that in this species the endothecium (end.) alone is fertile (Fig. 3).

As Kashyap and Dutt have already stated there is no columella in *N. levieri*. In *N. flabellata*, a species which also lacks a columella, the late Prof. Goebel observed that the archesporium arises from the endothecium, but whether the inner cells of the amphithecium are fertile or not he could not definitely ascertain.[2] He remarks that these cells like the endothecial cells are rich in the protoplasmic contents.[3] In the young sporogonia of *N. levieri*, also, sometimes similar amphithecial cells are seen, but a comparison with the older embryos shows that these cells never produce the archesporium. This fact suggests that *N. levieri* has been derived by reduction from a species in which the amphithecium was fertile. The columellate species of *Notothylas* would thus seem to be primitive, while those without it are reduced.

Several authors (Lang[4], Kashyap[5] and Bartlett[6]) have already emphasized that *Notothylas* shows signs of reduction in the species studied by them. In *N. indica* and *N. levieri*, too, as I have shown elsewhere[7] although the capsules usually remain enclosed within the involucre they generally open along one suture as in *Anthoceros Hallii*.[6]

S. K. PANDE.

Department of Botany,
University of Lucknow,
December 27, 1932.

[1] S. R. Kashyap, and N. L. Dutt, "Two Indian Species of the Genus *Notothylas*," *Proc. Lahore Phil. Soc.*, Sec. IV, 1925.

[2] In a recent paper (*Journ. Ind. Bot. Soc.*, **11**, 170, 1932) I wrongly stated that according to Prof. Goebel the whole of the amphithecium gives rise to the wall.

[3] K. Goebel, *Organographie der Pflanzen*, Zweiter Teil, 1915–18.

[4] W. H. Lang, *Ann. Bot.*, **21**, 201-10, 1907.

[5] S. R. Kashyap, *Liverworts of the Western Himalayas and the Punjab Plain*, Part I, 1929.

[6] E. M. Bartlett, *Ann. Bot.*, **42**, 1928.

[7] Pande, *Journ. Ind. Bot. Soc.*, **11**, 1932.

An Interesting Case of Maternal Care in an Aquatic Cockroach, *Phlebonotus pallens* Serv. (Epilamprinæ).

INSTANCES of maternal care are rarely met with outside the order Hymenoptera. It is, therefore, of great interest to record an example from among the cockroaches.

Shelford in his book entitled "A Naturalist in Borneo" mentioned that in the two viviparous species of cockroaches, namely, *Pseudophoraspis nebulosa* and *Phlebonotus pallens*, the newly hatched nymphs swarm on to the body of the mother and cling there.

On the 12th June 1929, I collected a female specimen of *Phlebonotus pallens* near the edge of the water channel of a small stream about six miles from Yercaud (4,500 ft.), Shevroy hills, South India. At the time of collection the specimen showed no extraordinary features and was preserved in spirit along with other aquatic fauna collected from the locality. Recently when the collected material was being sorted by my assistant, Mr. S. Rebiero, it was noticed that this cockroach had about one dozen young ones under its wings, while some were lying loose in the tube. The young ones were very securely packed under and could easily be seen through the wing covers which were now almost clear. A photograph of the specimen with some nymphs *in situ* is given in the figure.

The wing covers of the specimen were carefully displaced to ascertain if and how the nymphs were clinging to the body of the mother. All the nymphs were noticed to be quite free from the body of the mother. This also indicates that they most probably do not at this stage take any food from the mother, as is the case in some other insects. The nymphs are yellow or pale brown in colour and have patches of minute stiff dark hairs on several regions of the body.

The female cockroach does not look at all bulky nor was it awkward in its movements when it was carrying the young ones. The wing covers are large and arched and together with the upper side of the abdomen which is depressed from a chamber inside which the nymphs can be carried about comfortably.

In view of the fact that cockroaches have numerous enemies, the habit of carrying the young ones in the fashion described above appears to be a very efficient safeguard for the protection of the progeny. In life, the wing covers are opaque and the young ones lying under them are so nicely packed that the human eye cannot easily detect on superficial examination that the individual is carrying so many young ones on its body. Moreover, as will be readily understood, this habit, in addition to securing the safety of the nymphs against the attacks of enemies, is very useful for dispersing the species.

I am very thankful to Dr. R. Hanitsch of Oxford, who kindly named the cockroach for me.

HEM SINGH PRUTHI.

Zoological Survey of India,
Indian Museum, Calcutta.
February 2, 1933.

An Unusual Growth Phenomenon in *Coleus barbatus* Benth.

THE Labiate member *Coleus barbatus* Benth. is quite common at high elevations up to 8,000 feet, chiefly in the sub-tropical Himalayas and is rather a hardly herbaceous plant. It grows in rocky situations and its root is tuberous which, according to Cooke,[1] is pickled and eaten by the natives.

In October 1931 (at Naini Tal) while changing pressed plants after a fortnight to fresh drying sheets, certain tiny buds were found jutting out from the region a little above (about 25 mm.) the broken end of the stem of *Coleus barbatus*. The production of buds on dry specimen, specially under such an abnormal condition as that of the plant press, aroused some interest and a close observation was, therefore, made on the very same specimen under similar conditions for a period of about four months.

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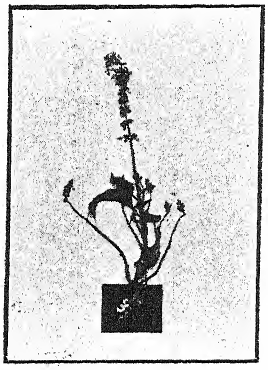
[1] *The Flora of the Presidency of Bombay*, **2**, Part II, 1906.

As a result it was found that the buds continued to grow under the herbarium-sheet and by the end of sixteen weeks each of them had attained a length of about 10 mm. They were, however, vegetative in character. On dissecting one of them out, small leaves were found arranged in the manner as in the ordinary vegetative buds. Owing to their being shaded from light under the herbarium-sheet, the buds had not developed the characteristic green coloration (see photograph). Nevertheless, when exposed to light, they turned green.



Coleus barbatus : The herbarium specimen showing lax central inflorescence and the white vegetative buds (in the black square). × 1/10.

At the same time, it might be mentioned here that the central inflorescence, at the outset, was compact with open flowers. But during the four months that the observations were continued, it was found that the inflorescence-axis also kept on elongating, thus making the whole inflorescence lax (see photograph). The increase in length measured 26 mm. There was, however, no such change observed in the lateral younger inflorescences in which the flower buds had not opened at all.

This peculiar behaviour of *Coleus barbatus* is really interesting as it demonstrates the enormous power of endurance of the plant even under the most unfavourable conditions of the plant press with great pressure and lack of water and light.

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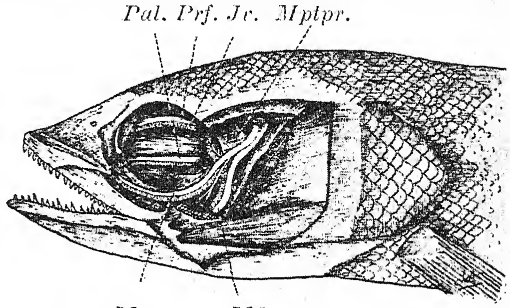
The "Metapterygoid Process" in the Skull of *Ophiocephalus striatus.*

ONE of the few interesting cranial features of *Ophiocephalus striatus* is the presence of a flat, prominent metapterygoid process. The palatoquadrate bar articulates with the cranium not only by the palatine in front and through the hyomandibular behind, but also by the metapterygoid process, immediately behind the orbit and in front of the Trigeminofacialis chamber. The upper edge of the process is incompletely ossified. A careful study of this structure in other animals clearly shows that the metapterygoid process is homologous with the "Processus ascendens" of Dipnoi and Tetrapoda. The topographical relations of this process



Dissection of the head of *Ophiocephalus striatus* to show the "metapterygoid process" and its relationship with the neighbouring blood vessels and nerves.

Jv.—Jugular vein. *Mx.*—Maxillary branch of the V nerve. *Md.*—Mandibular branch of the V nerve. *Mptpr.*—Metapterygoid process. *Pal.*—Palatine branch of the VII nerve. *Prf.*—Profundus branch of the V nerve.

and the processus ascendens with the nerves and blood vessels are identical. The profundus branch of the V nerve and the jugular vein (*vena capitis lateralis*) pass on the inner side of the metapterygoid process, while the maxillary and the mandibular branches of the Trigeminal pass on its outer side. This feature of the pterygoquadrate bar has not been so far described among any of the Teleostomi.[1] A complete comparative account of the skulls of various members of the family *Ophiocephalidæ* and *Cyprinidæ* (chiefly *Labeo, Catla, Cirrhina,* etc.) will be shortly published elsewhere.

B. S. BHIMACHAR.

Department of Zoology,
Bangalore,
January 28, 1933.

[1] E. S. Goodrich, *Studies on the Structure and Development of Vertebrates*, p. 413, London, 1930.

Total Efficiencies of Soft X-Ray Excitation and Secondary Electron Emission from Metal Faces.

A LARGE amount of experimental work[1] has been done on the emission of secondary electrons from metal faces due to bombardment by a stream of primary electrons, accelerated by applied potentials less than about 500 volts. However, investigators of this phenomenon have always confined themselves to the measurement of the ratio of the secondary to the primary current as a function of the applied potential and to the observation of critical potentials at which this ratio showed sudden changes. It has recently been shown by me[2] that this ratio for any potential in the case of a given metal is structure sensitive.

Farnsworth[3] has studied the velocity distribution of the secondary electrons by the method of retarding potentials. Since the translational energy of an electron is proportional to the potential to which it is subjected, we can show easily that if f_1 is the fraction in the secondary beam having a velocity V_1, the efficiency of the secondary emission is $f_1 V_1/V$ where V is primary potential. Such efficiencies calculated from Farnsworth's curves for Cu, Fe, Ni and Ag, show generally an initial rise till about 10 volts and then a gradual decrease. This decrease at relatively higher potentials is strikingly similar to the decrease observed in the efficiency of soft X-ray excitation by Richardson and Robertson[4]. Similar experiments by me on polycrystalline and 100 faces of Ni show that the efficiencies are equal in both cases though the ratios of the secondary to the primary current are different at any potential.

This similarity in the secondary electron emission and soft X-ray excitation gains significance from the experimental investigations of Rudberg[5], who finds a large number of slow electrons (having less than 10 volts energy) in both the cases. This fact helps us to account for the observed saturation tendencies in the soft X-ray total intensity curves obtained by Richardson and Robertson[6] and Nakaya[7]. It is obvious that the absorption of the low velocity photoelectrons becomes rapidly more important as the depth of penetration of the soft X-rays is increased by increasing its hardness.[8] Assuming with Richardson and Chalklin[9] that the number of photoelectrons n_0 produced in the medium of the photoelectric plate by the soft X-radiation at an applied potential V, is proportional to this potential and that the depth of penetration is proportional to the average energy of the soft X-ray quantum, we obtain for n the number of photoelectrons leaving the target the expression

$$n_0 \epsilon^{-\beta V} \text{ or } \alpha V \epsilon^{-\beta V}$$

Nakaya's results agree very satisfactorily with this expression.

Full details of this letter will appear in two papers, one in the *Proceedings of the Royal Society* and the other in the *Journal of the Annamalai University*.

S. RAMACHANDRA RAO.

Annamalai University,
Annamalainagar,
February 14, 1933.

[1] For details and previous work, see S. R. Rao, *Proc. Roy. Soc.*, **A 128**, 41, 1930.

[2] S. R. Rao, *Proc. Roy. Soc.*, **A 128**, 57, 1930.

[3] H. E. Farnsworth, *Phys. Rev.*, **31**, 405, 1928.

[4] O. W. Richardson and F. S. Robertson, *Proc. Roy. Soc.*, **A 115**, 280, 1927.

[5] E. Rudberg, *K. Sv. Vet. Handl.*, **7**, 1, 1929: *Proc. Roy. Soc.*, **A 127**, 111, 1930.

[6] O. W. Richardson and F. S. Robertson, *Proc. Roy. Soc.*, **A 124**, 188, 1929.

[7] U. Nakaya, *Proc. Roy. Soc.*, **A 124**, 616, 1929.

[8] S. R. Rao, *Phy. Rev.*, **41**, 374, 1932.

[9] Richardson and Chalklin, *Proc. Roy. Soc.*, **A 110**, 273, 1926.

Engystomatid Tadpoles.

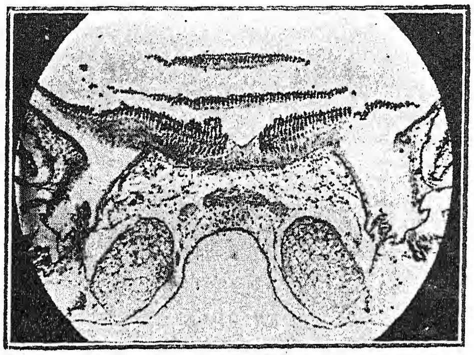
THE usual diagnosis for distinguishing the tadpoles of the families Ranidæ, Bufinidæ and Engystomatidæ[10, 11] is that those of the two former possess rows of larval teeth and horny jaws and those of the latter possess none. In fact the provisional dental characteristics and the shape, size and colour of the jaws of the tadpoles have been used for identifying the adult anura.[12] In examining recently sections of the larvæ of *Cacopus systoma* I noticed that teeth do occur, though there is a total absence of the teeth in the tadpoles of *Microhyla* and *Kaloula*. I understand that the teeth which are used for taxonomic

[10] N. Annandale and C. R. Narayana Rao, *Rec. Ind. Mus.*, **15**, Part I, No. 3, 1918.

[11] N. Annandale, *Memoirs As. Soc. Bengal*, **6**, 118, 1917.

[12] C. R. Narayana Rao, *Rec. Ind. Mus.*, **15**, Part I, No. 4, 1918.

purposes will not be a safe guide in the case of Engystomatidæ, in which the character, shape and position of the spiracle, the tail fin, the caudal flagellum and relative proportions of the body are more generally relied upon for diagnosis. The question arises whether the horny teeth of the tadpoles of *Cacopus systoma* represent an arrested stage of development or whether they are vestigial remnants in the process of disappearance. The latter seems the more probable view.



Transverse section of a 20 mm. tadpole of *Cacopus systoma* showing three rows of larval teeth.

If the tadpoles of Cacopus are examined under the microscope it is easy to detect a horny rim investing the free margin of the lips and the teeth occur in various stages of growth, forming minute irregular rows which sections of the oral cavity reveal. All the Engystomatid tadpoles occur almost as a rule on the surface of the tanks and rain

Longitudinal section of the intestine showing the contents.

puddles away from the water margins and are exclusively surface feeders. On the other hand, those of the Ranid and Bufonid families frequent water margins where there is a dense vegetation. Observations made on their feeding habits both in nature and in the laboratory tanks show that the tadpoles of these two families rasp the succulent vegetation, pieces of meat and do not hesitate to develop cannibalistic propensities. Sections of the intestines of the tadpoles of Engystomatidæ show the occurrence of a large variety of micro-organisms, like diatoms, protozoa, rotifera and copepoda. They have never been noticed to nibble vegetation or meat and are easily victimised by the stronger and more predaceous Ranid tadpoles. This habit of passively imbibing the micro-organisms must account for the rapid disappearance of the provisional teeth which in *Cacopus systoma* are therefore vestigial and in the process of disappearance. In the tadpoles of *Microhyla* and *Kaloula*, they have completely disappeared.

I reproduce above the microphotographs of the sections of the intestine of the tadpole and of the buccal region of *Cacopus systoma*.

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February 20, 1933.

Amphiboles in the Bababudan Iron Ores.

IN accounting for the origin of the banded iron ore rocks of the Bababudan area, it has been suggested[1] that they are derived from the decomposition of original schists rich in highly ferruginous amphiboles like cummingtonite and bababudanite—which are sometimes seen in the ferruginous quartzites. An obvious difficulty in accepting this explanation has been to account for what has happened to the large amount of magnesia (Bababudanite—12·11% ; Cummingtonite—18·68%)[2] which must necessarily have been found associated with the iron, constituting the original amphiboles.

In the course of a recent detailed examination of several sections of the Bababudan range, a remarkable fact has been noticed that the occurrence of these minerals, *viz.*, cummingtonite and bababudanite, in the iron ore rocks, is confined to narrow zones

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[1] W. F. Smeeth, "Notes on a Variety of Riebeckite (Bababudanite) and on Cummingtonite from the Mysore State," *Rec. Mys. Geol. Dept.*, **9**, pp. 86, 87.

P. Sampat Iyengar, "Report on the Geology of Parts of Hassan and Kadur Districts," *ibid.*, p. 73.

[2] W. F. Smeeth, *op. cit.*, pp. 90, 91.

always at the contact of the intrusive trap rocks of the area. This, together with the fact that these amphiboles occur as acicular and lath-shaped crystals—as a rule fresh and glistening—and that when their present distribution in the rock is carefully examined, these acicular crystals are seen running right across the bands in the original rock, seems definitely to suggest that they may be only later minerals developed at the intrusive contacts of the traps with the iron ore rocks and have, therefore, little or nothing to do with the origin of the latter.

The probable mode of origin of the iron ore rocks is receiving our attention and a detailed account of the nature of the bandings in the hematite quartzites together with the chemical and optical characters of the contact minerals will be published elsewhere.

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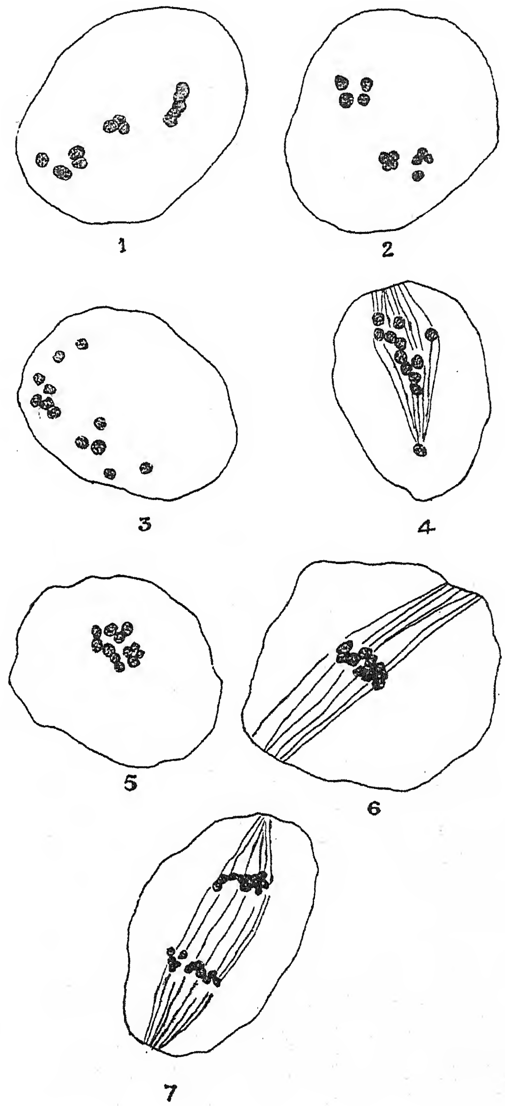
January 30, 1933.

Haploid Plant in Rice (*Oryza sativa*).

HAPLOIDY among seed plants is of very rare occurrence, and the stray cases recorded in a few genera have arisen in hybridization where, due to failure of fertilization, the embryo under stimulus has developed with one set of haploid chromosomes only. There have been only two recorded instances of this phenomenon in cereals. Gaines and Aase (1926) observed among the F_1s of an intergeneric cross (*Triticum compactum* × *Aegilops cylindrica*), a haploid wheat and described its sporogenesis. Recently Morinaga and Fukushima (1931) discovered a haploid rice plant, among the F_1 progenies of a cross between a dwarf and a normal variety of rice. They were able to identify its haploid nature only by the examination of its somatic chromosomes in root tips, as the observation was made too late to study the sporogenesis of the plant.

At the Paddy Breeding Station, Coimbatore, the study of polyembryony in rice has been in progress for some time. In one of the pure lines, some seeds, approximately in the proportion of 1 : 1000, were seen to give rise to two seedlings. A large number of these twins had been planted out separately and in all the cases except one mentioned below, the twins proved identical. In this exceptional case while one of the twins was normal, the other was found slightly dwarfed, flowering later than the normal, with a poor emergence and smaller spikelets with complete absence of anthesis. Examination of this plant at sporogenesis revealed twelve univalent chromosomes distributed irregularly (Figs. 1 & 3) in the



nuclear area and later assorting at random at the two poles with the absence of the usual metaphase stages. Only a few cases of this random distribution of chromosomes are figured (Figs. 2 & 4). This irregular distribution of univalents and their random assortment at the poles is in marked

contrast to the normal heterotypic division in the normal plant where the metaphase and the anaphase stages are characteristically regular (Figs. 5 to 7). The peculiar behaviour of this plant at sporogenesis is similar to that reported of haploids in other plants. It is suggested that this haploid might probably have arisen from one of the cells of the female gametophyte. Detailed cytology of this plant is under investigation and will form the subject of a separate article.

Reference to Figures.

(Drawn with the aid of a Camera Lucida at stage level × 1500).

Figures 1 to 4 .. Haploid.
Figures 5 to 7 .. Diploid.

Reference to Literature.

Gaines and Aase (1926), *Amer. Jour. Bot.*, **13**, 373-385.

Morinaga and Fukushima (1931), *Jap. Jour. Bot.*, **6**, Abs. p. 13.

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N. PARTHASARATHI.
S. RAMANUJAM.

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Lawley Road P. O.,
Coimbatore,
February 24, 1933.

Helminth Parasites from Certain Fresh-Water Fishes of India.

DURING the course of our investigation on the life-history, economic importance and bionomics of the fresh-water fishes of the Nizam's Dominions, we came across the following parasites in several species of the fishes obtained from the local rivers, *viz.*,

(*a*) *Philometra* sp. (♀), one half of which was pink and the other half whitish in colour, was obtained from a siluroid fish, *Wallago attu*.

(*b*) *Eustrongylides larvæ*, usually purple in colour, were obtained from *Ophiocephalus striatus*, *O. marulius* and *O. punctatus*, *Gobius giuris* and *Mastacembelus armatus*.

(*c*) Specimens of *Isoparorchis hypselobagri* (Billet) were obtained from all the species of fishes mentioned in (*a*) and (*b*) and in addition, from *Ophiocephalus gachua* and *Callichrous malabaricus*. The worms are especially very abundant in the gas-bladder of *Wallago attu*.

(*d*) One form possibly *spirurid larva* (?) has been obtained from *Saccobranchus fossilis*. In this fish another interesting form of parasitic worm has also been discovered which will be described later on.

(*e*) *Contracæcum larvæ* have also been obtained from *Ophiocephalus punctatus*.

It is interesting to note that these parasitic worms are of very wide distribution amongst the fresh-water fishes of India,—most of the Siluroids and Ophiocephalids are predaceous in their habits and either their cannibalistic instincts or their habit of one species preying upon another species that accounts for such a wide prevalence of worms amongst the piscine fauna. It is likely that the adult forms of most of these worms will be ultimately found in fish-eating birds, or some aquatic animals, *e.g.*, predatory fishes, certain reptiles, mammals, etc., the infection may even extend to man as well. Their mode of "anchoring" presents some interesting variations in different species of fishes: some are attached to the mesentery, either lying free, or in an encysted condition, while others bore their way through the muscles of body-wall, and there they may be quite free, or form cysts which appear blackish, not unlike masses of disorganized blood-clots and in certain cases they may even perforate the outer skin of the fish. Further work covering a wider field of the fish-fauna of this State is going on at present in this laboratory, and our results will be published elsewhere. We are aware of certain cestode and tremetode parasites already described by others, infesting a few fresh-water fishes of India.

Here we wish to express our great indebtedness to Dr. H. A. Baylis of the British Museum and Mr. G. D. Bhalerao, Helminthologist, Imperial Institute of Veterinary Research, Muktesar (U. P.) for the correct identification of the worms mentioned above.

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The Industrial Outlook.

[NOTES ON THE ELECTRIC RAILWAYS IN BOMBAY AND MADRAS.]

By Dr. Ram Prasad.

THE steam locomotive, although highly improved in recent years, has got its own limitations as regards efficiency, tractive effort and speed. The application of electricity for traction has proved its superiority over the steam drive in the above respects and the railways all over the world are electrifying their railroads utilizing either economical hydro-electric power or steam electric power from large central stations. Not only the suburban lines near big cities, but also the main lines radiating from centres of trade, commerce and industry have greatly benefitted by the conversion into electric drive. In Switzerland where there are no coal fields, almost the entire railway system has been electrified as the country is rich in water power. In recent years the railways in India have been carefully considering the change into electric drive and the schemes carried out by the G.I.P., B.B. & C.I., and the S.I. Railways, have proved the superiority of the electrified systems to such an extent that other railways will follow suit in due course.

The heavy suburban traffic of Bombay, a city of nearly 1¼ million inhabitants, and the important long distance passenger and goods traffic especially over the Ghat sections, where the elevation suddenly rises up to 2000 ft. above sea level with gradients of 1 in 37, constitute conditions that are very favourable for electric drive especially as power was available from hydro-electric power stations nearby. The B.B. & C.I. Railways have electrified their suburban section between Bombay and Borivli (30 miles) and the G.I.P. Railway have electrified not only their suburban sections between Bombay and Kalyan (30 miles) but also their main lines from Kalyan to Poona on the South-East and to Igatpuri on the North-East.

The South Indian Railway have electrified their suburban section from Madras Beach to Tambaram (18½ miles) and are also contemplating main line schemes to be taken up in the near future.

The suburban schemes of the G.I.P. and B.B. & C.I. Railways are both on the broad gauge and are similar in design and equipment of sub-stations including rotary converters, etc. The suburban scheme of the S.I. Railway is on the metre gauge and their sub-stations are equipped with mercury arc rectifiers instead of rotary converters. The main line scheme of the G.I.P. Railway is an extension of their suburban system, but the traction is carried on by suitable passenger and goods locomotives, the latter equipped with regenerative braking for service over the Western Ghats between Kalyan and Poona and Igatpuri.

The following is an abstract of the technical features of the G.I.P. Railway:—

1. Capital Expenditure—	
Suburban Scheme	Rs. 2·74 crores
Main line Scheme	Rs. 6·50 ,,
2. Route mileage of track electrified	181 miles
Length of single track electrified including sidings ..	571 ,,
3. Number of Suburban motor coaches	53
Number of Passenger locomotives	21
Number of Freight locomotives	41
4. Aggregate HP of Passenger locomotives	51,990
Aggregate HP of Freight locomotives	1,06,600
5. Number of sub-stations ..	15
Aggregate capacity of sub-station plant	1,00,000 Kw.
6. Steam Power Plant and equipment	4 alternations of 10,000 Kw. each. 6 Boilers of 60,000 lb. steam per hour each.
7. Length of 100,000 volts Transmission line	272 miles.

The suburban system of the G.I.P. Railway was electrified by 1925 and the main lines by 1929. The traction is of the 1,500 volt D.C. system, power being derived through rotary converters in the various sub-stations. Four of the sub-stations receive their power from the Tata Hydro-Electric Companies, at 22,000 volts from the Tata stations at Dharavi and Kalyan. The other sub-stations which feed the main lines from Kalyan to Poona and Igatpuri are fed from the G.I.P. Railway steam electric plant situated near Kalyan, through extra high tension lines at 95,000 volts which run mostly parallel to the railway lines. The wisdom of having installed a steam power plant, when there was sufficient hydro-electric power available

nearby has been questioned. The railway authorities seem to justify the steam plant and say that at the time of negotiations with the Tata Companies, conditions being adverse, there were doubts if they could guarantee priority of supply in the event of shortage of water following a bad monsoon and consequently continuity of service was not certain. In any case if conditions have improved since, it would be economical to draw more power from the Tata Companies and conserve their coal for places where the electrification has not been extended, especially as the railway power plant is so designed as to inter-link with the Tata network.

The steam power plant is designed for pulverised coal and is equipped with 6 boilers each of 60,000 lbs. per hr. steam output and 4 turbo alternators each having an economical and continuous maximum rated output of 10,000 Kw at 6,600 volts with an overload capacity of 20% for 2 hrs. and 65% for 2 minutes. Each generator is connected through an oil circuit breaker to the low tension side of its own 11,000 KVA 95,000 volts step-up transformer and also to the high tension side of its own 1800 KVA unit transformer which feeds the auxiliaries connected with that set. In all the G.I.P. sub-stations the converting plant consists of suitable transformers and rotary converter sets each comprising two 750 volts 1,250 Kw machines in series to give a 1,500 volts D.C. supply. In three of the sub-stations, all switchgear including that for starting, synchronising and connection to the busbar are designed for manual operation, and in others there is automatic operation, *i.e.*, each rotary converter is automatically started, synchronised, and connected to the busbars following the closing of a low voltage control switch. Six of the sub-stations on the main lines are unattended and fitted for supervisory control from the neighbouring attendant sub-stations. All the rotary converter sets and their switchgear are designed for receiving power from the 1,500 volts D.C. line, from the locomotives regenerating as well as for normal operation. A portion of the regenerated energy is absorbed by ascending trains up the ghats and the remainder is converted into alternating current in the sub-stations and delivered to the transmission lines. On the average about $4\frac{1}{2}$% of the input to the rotary converters is returned to the transmission lines. Taking the total input as 6,00,00,000 Kw. hrs. per annum, the energy returned to the high tension lines would be 27,00,000 Kw. hrs. per annum. This saving is ample to pay the capital charges on the extra cost of equipping the freight locomotives with exciters and additional switchgear for regeneration, a further advantage being the reduction in brake block renewals.

The locomotives have been designed to meet the exacting conditions of varying temperatures from 40° F. min. to 130° F. max. and the heavy monsoons near Bombay. For the suburban service each train unit consists of one motor coach and three trailers, the normal train during rush hours being made up of 2 units. Seating capacity of each unit is I class 15, II class 42, and III class 384. The motor is of 275 HP and the weight of the four-coach unit is 218 tons, *i.e.*, 5 HP per ton of train. The freight locomotives are designed with the wheel arrangement comprising of 2 sets of 3 coupled axles, so that there is less tendency to skidding of wheels and no chance of breaking of coupling when starting up the 1 in 37 gradients and running away in down grade. They are equipped with 4 motors each of 650 HP 1,500 volts rather than 6 of 750 volts so that a lower crawling speed is possible. Further they are equipped with axle driven generators for regenerative working when the locomotives are hauling trains down the ghats. The complete electrical equipment is easily and conveniently divided into 2 groups so that in the event of any electrical failures one group can be immediately isolated without affecting the operation of the other thus reducing the possibility of a train being stalled and blocking the road. All the auxiliaries, such as vacuum pumps and compressors, are in duplicate and a 50 volts battery is installed with sufficient capacity to give 4 hours supply for lights and control circuits.

The passenger locomotives for the main lines were designed to meet the growing demand of traffic with improvement in the timing between Poona and Bombay. They have a tractive effort of 7,500 lbs. at 70 miles per hour and can maintain a speed of 57 miles per hour up a gradient of 1 in 150. These locomotives have to work in combination with a freight locomotive while going up the ghats and should share the load properly at the speed desired, that is, of the total tractive effort of 40,000 lbs. required, the passenger locomotive should be responsible for 16,000 lbs. leaving 24,000 lbs. for the freight engine, both running at a speed of

about 30 miles per hour. Similarly, the locomotives have to run in combination under regenerative control down the ghats. The motor equipment of the passenger locomotive consists of six motors of 750 volts with two groups of control apparatus and all safety devices. It is remarkable that 41 freight locomotives and 24 passenger locomotives have efficiently replaced 171 steam locomotives including 96 ghat engines.

The G.I.P. Railway main line electrification scheme is the largest and the most comprehensive in the British Empire, with perhaps the recently electrified Southern Railways between London and Brighton coming next. The combined G.I.P. and B.B. & C.I. suburban electrification schemes have helped Bombay to successfully overcome the housing problem and develop the suburbs till now considered impracticable.

THE SOUTH INDIAN RAILWAY ELECTRIFICATION—MADRAS.

The S.I. Railway have adopted the 1,500 volts D.C. system very similar to the traction system of the Bombay Electric Railways, but the track is of metre gauge and the scheme is of special interest in that it was not merely the conversion of existing steam-operated lines to electrical working, but included the construction of new tracks and stations to accommodate suburban traffic between Madras and Tambaram, that had increased so much as to impede the main line services. Another novel feature is that the 1,500 volts D.C. supply is obtained by means of 1,500 volts 1,500 Kw mercury arc rectifier sets instead of rotary converters used in Bombay. Power is obtained from the steam power plant of the Madras Electric Supply Corporation at 33,000 volts and is supplied to the mercury arc rectifiers through suitable transformers and switching apparatus which are designed for automatic operation. These rectifiers can take 100% short time overloads easily.

The service on this system was opened in April 1931 and has been working quite satisfactorily. The traffic has tremendously increased with better speed and comfort and has electrification scheme. A new double track for the electric trains has been constructed from Madras to Tambaram ($18\frac{1}{2}$ miles) and certain shunting yards near Madras have been electrified so that shunting operations and freight services can be carried out with electric locomotives. There are two rectifier sub-stations, one at Egmore and the other at Meenambakam, with the car sheds located at Tambaram.

There are 17 articulated coach units, each consisting of one motor coach and 2 trailer coaches; 4 locomotives and 2 battery tenders. The articulated motor coach units are arranged for multiple unit working, so that trains may be made up with 3, 6 or 9 coaches according to the traffic requirements. The electrified equipment has been designed to give an average speed of 40 miles per hour with a fully loaded train over the whole distance with station stops at an average interval of $1\frac{1}{2}$ miles. A three-coach unit is carried on 4 bogies and the power equipment consists of 4 motors of 122 HP each, connected permanently in pairs in series, one pair being mounted on each of the two intermediate bogies. The motors are of self-ventilated type, but owing to the excessively dusty conditions the ventilating air is drawn from inside the coach through ducts and sliding flexible joints. Power control is on the all-electric can shaft system similar to that in use on the G.I.P. Railway, and the whole of the control equipment is housed in a compartment at one end of the centre coach, which also contains a 4 Kw 1,500/60 volts motor generator set for supplying the control and lighting circuits, and exhauster driven by a 1,500 volts motor. An emergency battery is also provided, which is charged automatically and floats across the terminals of the motor generator set. Ten of the train units contain I, II, III class and seven contain entirely III class. The weight of a unit is 73 tons. The 4 locomotives are fitted with articulated bogies each equipped with two nose suspended axle-hung motor rated at 160 HP. As in the case of the motor coaches, the ventilating air is drawn from the interior of the vehicle which in turn has air inlets fitted with filters. The superstructure is of the box cab type with the control equipment mounted in a centre compartment, with a driving position at each end. The electrical equipment of the locomotives is generally similar to that of the motor coaches with the exception that it is not arranged for multiple unit operation, and 3 running positions are provided in series and also in parallel by means of weakened field notches. The locomotives are capable of hauling 500 ton freight trains or 250 ton passenger trains at a speed of from 25 to 40 miles per hour. They are 32 ft. long over buffers, $8\frac{1}{2}$ ft. wide with a weight of 42 tons. Braking of the units is by

compressed air, but vacuum brakegear is fitted in addition, to suit the existing rolling stock.

One of the chief difficulties encountered in laying out this electrification scheme was the fact that there were a number of small yards at some distance from the main line which could not conveniently be provided with overhead construction although at the same time it was extremely undesirable to have to provide a steam locomotive whenever movement had to be carried out at these yards.

The problem was solved by providing in addition to the locomotives two battery tenders equipped with heavy duty batteries capable of supplying power to the locomotives at 440 volts. When a locomotive is required for service of the kind indicated one of these tenders is attached to it and after the limit of overhead construction has been reached the pantograph is lowered and by changing over a single switch the locomotive runs on the 440 volts supply from the battery. These tenders which weigh only 21 tons have a capacity of 158 Kw hrs. at the 5 hr. rate of discharge of the battery and they are equipped with a complete charging switchboard and other auxiliaries.

The South Indian Railway have not only built new type of stations to handle the suburban traffic on the electric trains, but have done away with all the level crossings in Madras City which has improved the main roads and relieved the traffic congestion. When the hydro-electric power of Pykara is available for the South Indian Railway, they may take up the electrification of the main lines near Coimbatore, Madura and Trichinopoly and also the mountain railway up the Nilgiris.

The Government of Mysore are also investigating the electrification scheme for the Nanjangud-Mysore-Bangalore system. Electric power is available at every railway station on the line between Nanjangud and Bangalore, in addition to the 35,000 volt sub-stations at Bangalore, Closepet, Chennapatna and Mysore. The scheme as worked out by the South Indian Railway for their metre gauge lines with mercury arc rectifiers seems adaptable with advantage for the Mysore Railways. Unlike Madras and Bombay, Mysore cannot buy cheap seaborne coal, is located far away from Indian coalfields and is compelled to pay very high rates for the coal required for their locomotives. Both the Mysore Railways and Cauvery Hydro-Electric Power schemes are owned by the State which helps a great deal in the economy of the electrification. The approximate cost of electrification may be in the neighbourhood of 18 to 20 lakhs. With a guarantee of power supply from the Cauvery Power Station at Sivasamudram and prospects of saving money going out of Mysore to the extent of the cost of coal purchased from outside the State, the electrification scheme deserves very careful consideration so that the details will be worked out at an early stage and the conversion to electric drive may be taken up with advantage.

The Railways which radiate from Calcutta are also considering suburban electrification as a first step which may later lead to main line electrification. Unlike Bombay, Calcutta is situated very near the largest coalfields in India, and it is possible to generate power economically in large central stations with steam power even though there are no big hydro-electric power stations nearby. The ordinary steam locomotive has to carry its own raw materials, such as coal and water, and use them in a boiler whose efficiency is far below that of large modern pulverised coalfield boilers and drive an engine whose efficiency is much lower than that of the central station steam turbines. The logical procedure is to generate power economically at a suitable steam or hydro-electric power station and distribute the energy to hundreds of locomotives with minimum of loss. The first step in nation-building is the conservation and proper development of the natural resources, and electrification plays a very important part.

Traction on the D.C. system is one phase of development, as there are several railways running on A.C. systems using single phase or three phase supply. The mercury arc rectifier which has just come into the field of D.C. traction has various modifications, which make it useful in converting power from 3 phase A.C. systems to single phase A.C. or *vice versa*. Recent investigations have shown that the mercury arc rectifier will play a very important part in the future electrification schemes as it is capable of heavy overloads and adapts itself easily for automatic operation.

A Bureau of Mycology for India.

IN his Presidential Address to the Botanical Section of the Indian Science Congress last year, Dr. H. Chaudhuri advocated the establishment of a Bureau of Mycology in India and this suggestion is repeated by him on p. 180 of *Current Science* for December, 1932, where it is said that it has been expanded in the *Madras Journal of Agriculture* to include Entomology in a combined Bureau to cover both subjects.

The primary functions of such a Bureau would naturally be (1) to serve as a clearing house for the collection and dissemination of information and (2) to organize a system for the prompt identification of injurious fungi and insects. Subsidiary functions might be (3) to arrange periodical meetings of workers interested in the subject, (4) to facilitate the "circulation" of research workers through knowledge of the work going on at different centres, (5) to facilitate the exchange of material for study, (6) to keep in touch with manufacturers (*e.g.* of apparatus or spraying materials), (7) to provide for visitors good library, herbarium and museum facilities for consultative purposes, and (8) if possible to undertake the systematic revision of groups of organisms of economic importance where such revision is called for.

Experience has shown that the function (1) above is best fulfilled by the publication of abstracts of current literature, the formation of card indexes of past and present literature on specific subjects, and the answering of enquiries by correspondence. The maintenance of a lending library, where possible, is also useful. (2), (3) and (4) require no comment. (5) can best be met not so much from the immediate resources of the Bureau as by being able to make use of sources of supply that may be scattered throughout the world. This applies particularly to cultures and preserved specimens. (6) and (7) require no comment. (8) is necessary at times because it may be impossible to fulfil function (2) adequately without such a revision.

It will be seen that there is no need to duplicate (1) provided that it is adequately carried out somewhere else and the information conveyed in a suitable language. Both in Entomology and Mycology the existing organizations provide fully for all reasonable needs of English-speaking countries. None of the Dominions nor, indeed, any foreign country has found it necessary to set up similar organizations and there is no need for a separate Indian one. (2) is in most countries provided for in national herbaria, museums, and similar institutions, and India possesses the foundations for such (so far as fungi are concerned) in the Agricultural Research Institute at Pusa and the Herbarium of the Royal Botanic Gardens, Calcutta. The reason why the far-flung British Empire has needs transcending these local ones is that only at some one centre (which convenience and local facilities has dictated should, in most cases, be London) can all the scattered threads be gathered together and knowledge gradually gained of the identity of the organisms injurious to plants in many diverse regions of the globe, of their similarities and differences, and of the risks they might present if they became disseminated from one part of the world to another. Only one such centre is obviously required and it must keep in close touch with national centres in India and elsewhere. None of the other functions of a Bureau detailed above appears to require special provision in India, as they are either already sufficiently covered to meet local (as well as inter-imperial) needs or would be too costly to duplicate in any single country. (3), (4), (6) and (7) fall under the first of these considerations, (5) the second. In regard to this last, the collection of type cultures at Baarn in Holland and the Lister Institute in London are sufficient to meet the requirements of most workers with living fungi and the setting up of other collections is to be deprecated as liable to impair their efficiency. All other requirements of material for study from foreign or other outside sources can best be met through the agency of a central organization such as those in London. Function (8) is one that is only incidental to the work of a Bureau, but every research institution wherever situated could usefully engage in this much-needed study.

Unless, therefore, Dr. Chaudhuri has some other type of organization in view than that considered above, there would appear to be no need for separate Indian Bureau. The requirements of India are covered by the central Imperial organizations, which no local one could replace, for the reasons given above, without wholly unnecessary duplication and waste of money. The service of these central organizations is not "a

matter of grace" as Dr. Chaudhuri states. It is a service paid for in hard cash and at a far cheaper rate than could be obtained at any institution carrying on similar work in India, as it is subsidized by all parts of the Empire and each contributing country has only to pay a fraction of the total cost.

Dr. Chaudhuri's light-hearted remark that it takes months or even years to obtain a report on any material sent to the central organizations is sufficiently met by the following figures. In the two years 1930 and 1931 the average time that elapsed between the date on the forwarding letter from India and the date of the report from the Imperial Mycological Institute was 37·45 days, a period that includes the time taken in transit from India, probably for parcels about three weeks. In 1932 the average time was 47·72 days, but this difference is almost wholly accounted for by a single enquiry which took 132 days and involved a great deal of critical work.

E. G. BUTLER,
Director.

Imperial Mycological Institute,
Ferry Lane,
Kew, Surrey, England.
January 16, 1933.

* * *

THE many mycological workers in India will feel heartened by Dr. Butler's declaration that they can expect the service of his organization as a matter of right since "it is a service paid for in hard cash" and not given "as a matter of grace" as put by me through ignorance. We may perhaps now look forward to Indian mycologists being employed in Dr. Butler's Bureau, since India is paying part of the expenses.

I am very pleased to know of the prompt way in which enquiries from India are dealt with. If I complained about the delay in getting reports, it was due to my experience of the Bureau in its early days. The data now supplied by Dr. Butler, leave no doubt about the promptness with which enquiries are now attended to, and I feel certain that the Imperial Mycological Institute will now receive many more enquiries from India than before. Mycologists in India will feel indebted to Dr. Butler for this statement.

Now as regards my plea for the establishment of an Indian Bureau of Mycology, I fully agree with what Dr. Butler has said regarding the functions of a mycological bureau. Dr. Butler will no doubt grant that the Mycological Section at Pusa has been doing much of the work which he ascribes to such a bureau. If there is any duplication of the work that is being done in London, I maintain it is a necessary duplication, and every country has got to do that kind of work independently. But I would not suggest that the Indian Bureau should start publishing abstracts of mycological literature; that work is very efficiently done by the London Bureau. If, however, I am permitted I may suggest that along with the abstracts, the addresses of the authors may as well be printed. That will facilitate exchange of material direct.

My whole endeavour has been to press for the establishment of a culture bureau in India, similar to that of Baarn, where the cultures of fungi isolated here may be maintained and made available to the workers in India. The situation and climate of Pusa being unsuitable for the purpose, I suggested the establishment of a separate mycological bureau. Since the publication of my last letter, this matter has been discussed by the Imperial Council of Agricultural Research, India, and the idea accepted, and I am glad to state that efforts are now being made to find out the best way to give effect to it. Under the present financial condition the establishment of a separate bureau not being a feasible proposition, the best thing would be to develop the Mycological Section at Pusa into a proper mycological bureau. This involves refrigerating arrangements for maintaining cultures, which however need not prove an insurmountable obstruction as there is an ice-plant there which has got an output sufficient to meet the demand.

Mycological workers in India are indebted to the Mycological Section at Pusa for the help and facilities given there. If it now develops into a proper mycological bureau, and I have no doubt it shall do so soon, nobody will feel more happy, I am sure, than Dr. Butler who has been associated with it from the very beginning. There is need and scope for its development, and certainly money spent there will not be money wasted.

H. CHAUDHURI.

Punjab University,
Lahore,
February 14, 1933.

Marriage among the Ūrālis of Travancore.

By L. A. Krishna Iyer, M.A.

THE Ūrālis are a small jungle tribe found in the Peermede and Thodupuzha taluks of Travancore. Their life of isolation on the hills has kept them away from the civilizing influence of the plains with the result that they preserve most of their primitive customs and manners. It is proposed to treat here of their marriage customs.

Marriage is by exchange of sisters. No man can have a wife unless he has a sister whom he can give in exchange. An Ūrāli cannot purchase a wife from her parents by giving the equivalent in property of some kind, whether it be in goods, cattle, or money. A man who has no sister to offer in marriage has often to lead a life of single blessedness. Formerly, an Ūrāli married as many wives as he had sisters. Now a man does not marry more than two women. A number of young men remain unmarried for want of women. The scarcity of women as wives was caused in large measure by the selfish action of old men. The result is unequal distribution of women as wives between males of the community, the old men having more than the young who had to go without any. Cross-cousin marriage is also in vogue. The marriage ceremonial is very simple in form. It takes place both before and after puberty. The boy's uncle settles the marriage. The bridegroom and father go to the bride's hut and escort the bride to their hut, where the bride's party is treated to a feast. Dowry consists of bill hook, clothing and vessels.

Polygamy was widely prevalent formerly. It is now very limited. A man marries more than one woman for assisting him in his agricultural operations or for want of progeny by his first wife.

Polyandry is said to prevail where there is a surplus of men. Rev. Mateer observes that the Ūrālis practised polyandry like the Todas, but it seems to have died out. It is now observed that there are more males than females. In two hamlets there are 65 girls to 100 boys.

The system of marriage by exchange of sisters is found among the Ullādans and Malavēdans of Travancore, the Mādigas of Mysore, the Bhothiyas of United Provinces, the Garos of Assam, the Australians and other backward tribes of the world. It seems probable that this practice was at first a simple case of barter, and that it originated in a low state of savagery, when women had a high economic value as labourers, but when private property was at so rudimentary a stage that a man had no equivalent to give for a wife except another woman. The same economic motive might lead the offspring of such unions who would be cross-cousins, to marry each other, and thus the custom of cross-cousin marriage would arise and be perpetuated.

It is said that the exchange of sisters by their brothers was probably older than the exchange of daughters by their fathers, since relationship between brothers and sisters, children of the same mother, must have been well known and recognition of that relationship conferred on brothers a degree of authority which enabled them to exchange their sisters or their sisters' daughters for other women whom they either married themselves or gave in marriage to their sisters' sons.

The custom of cross-cousin marriage is considered to have arisen from exchange of women by brothers. It seems to have been the direct consequence of interchange of sisters in marriage and that the latter flowed directly from the economic necessity of paying for a wife in kind. Thus exchange of sisters co-exists with cross-cousin marriage not only among Ūrālis, the Ullādans, and the Malavēdans of Travancore, but among other tribes in other parts of the world.

A Bibliography of Zoological Work in India.

By P. W. Gideon,

Department of Biology, Karnatak College, Dharwar.

WITH a view to compiling a bibliography of the work done by zoologists in India, so as to afford a ready reference to all workers on Indian problems, I have asked through the Chairmen of the Boards of Studies in Zoology, Medicine and Agriculture of Indian Universities, all zoologists engaged in research or other work to co-operate by sending me reprints of their work published during the last five years (1928-32), and to give all information regarding the problems on which they are at present engaged.

In reply to this request reprints of publications and information regarding zoological work are coming in, and to avoid unnecessary correspondence I would like to bring to the notice of zoologists the following points:—

1. Care should be taken to mention the year and month of such publications where reprints are not sent.
2. Universities and Institutions as have been approached and are *not* engaged in any zoological work may kindly reply to that effect, as delay may be caused in waiting for their information.
3. Information of *work in preparation* is necessary, as a short review of the various centres of research with the various sections of zoology in which they are engaged, is contemplated.
4. So far the information received from the Chairmen, Boards of Studies in Zoology of a number of Universities, has dealt with the work done by the University Staff only. I should like it to be made clear that in order to compile a complete bibliography it is also necessary to have the work done by members of the Zoology Department in each college affiliated to the University.

I have also asked the various research institutions throughout India to furnish me with the same details, and would like to take this opportunity of asking private institutions and individuals engaged in zoological work to co-operate also. It would be very helpful if the necessary information could be sent in as early as possible as the work is to be completed during the long vacation, March to June 1933.

The following is a list of the Universities and research institutions I have already approached, but not included in this list there may be other institutions and individuals whose help is also solicited for a completion of the scheme.

UNIVERSITIES.—Agra, Aligarh, Allahabad, Andhra, Annamalai, Benares, Bombay, Calcutta, Dacca, Delhi, Lucknow, Madras, Mysore, Nagpur, Osmania, Patna and Punjab.

RESEARCH INSTITUTIONS.—

1. The Zoological Survey of India, Indian Museum, Calcutta.
2. The King's Institute, Guindy.
3. The School of Tropical Medicine, Calcutta.
4. The Department of Fisheries, Madras.
5. The State Research Laboratory, Rajkot.
6. The Government Museum, Madras.
7. The Prince of Wales Museum, Bombay.
8. The Imperial Council of Agricultural Research, New Delhi.
9. The Indian Central Cotton Committee, Bombay.
10. The Imperial Institute of Veterinary Research, Muktesar.
11. The Imperial Entomologist, Pusa.
12. The Locust Research Entomologist, Lyallpur.
13. The Indian Lac Research Institute, Ranchi.
14. The Central Research Institute, Kasauli.
15. The Fisheries Bureau, Chepauk, Madras.
16. The Department of Medical Services, Nova Goa.
17. The Department of Medical Services, Pondicherry.
18. The Veterinary Serum Institute, Bareilly.
19. The Colleges of Agriculture, Poona and Coimbatore.
20. The Forest Colleges, Dehra Dun and Coimbatore.
21. The Veterinary Colleges, Bombay and Madras.
22. The Medical College, Vizagapatam.

Research Notes.

On the Graptolites prepared by Holm.

OLIVER M. B. BULMAN, (*Arkiv for Zoologi*, Band 24, Hafte 2, 1932) in a series of papers makes a distinct contribution to our knowledge of Graptolites, based on the magnificent collection of 'etched' Graptolites prepared by Holm. The greater part of the material in the Holm collection was obtained from Gra Lituitkalk and the Glauconithaltig, Gra Vaginatumkalk of Oland and the Ordovician limestones. The forms described are referred to their particular stratigraphical formations and the paper is profusely illustrated with beautiful photographs and figures. The descriptions of the different genera are exhaustive and the paper forms an excellent work of reference for all students of Palæontology.

Continuous Cometary Spectrum.

THE continuous cometary spectrum has recently been attributed by Willi M. Cohn (*Astrophys. Jour.*, **76**, 277, 1932) to the bombardment of ions of different materials in the rarified tail of the comet by electrons assumed to be constantly emitted from the sun. Laboratory experiments are given which show that the cometary spectrum is unpolarised according to theory. On the other hand if the scattering is of the Tyndall type a complete polarisation is to be expected which is almost entirely absent in the violet type spectrum of comets. The appearance of CO^+ and N_2^+ bands favours the suggested origin of the spectrum and indicates that the pressure in comets may be of the order of 10^{-4} to 10^{-5} mm. of mercury. Since the electron velocity is reduced by its travel through the turbid medium of cometary matter, the theory explains also why with increasing distance from the head of the comet the maximum is shifted from 4000 to 4700 Å in the tail of the comet Morehouse.

Spraying in Coffee Production.

THE function of spraying in coffee production is the subject of two recent articles by W. W. Mayne in *The Planters' Chronicle* (**28**, 34, 53, 1933). After drawing attention to the fact that the Leaf-Disease is almost specific to coffee, the author adduces evidence to show that treatments like cultivation and manuring, though helpful to plant growth, will also, generally, favour the development of the fungus causing the disease. On the other hand, spraying eliminates the fungus and, by minimising the risk of leaf fall or destruction, it also provides the plant with an increased effective leaf area for the photosynthetic assimilation of carbon dioxide. The plant bears more flowers and fruits than it might have done in the diseased condition and thus gives a bigger yield of seed. The available evidence would also suggest that manuring, though helpful in maintaining soil fertility, does not appreciably increase crop-yields.

The author does not, however, explain how spraying leads to increased crop-production even in areas where the destructive effect of the Leaf-Disease is not perceptible. Furthermore, the effects of the sprayed chemicals both on the physiology of the plant and on the chemical composition and microflora of the soil into which it is ultimately washed down cannot be entirely ignored, particularly in the light of the literature that has been accumulating in recent years. It is known that the more progressive planters are liberal in their sprayings so that the quantities of chemicals thus applied per unit area would be considerable. It is suggested therefore that a systematic investigation directed towards the elucidation of the biochemical significance of spraying not only in the case of coffee but also in those of other plantation and horticultural crops of economic importance should be undertaken.

Kaolin Minerals from Felspar.

IN a recent number of *Journal of Geology* (**40**, No. 8) Messrs. A. E. Badger and Abde Ally have published a short note on their experimental work on the formation of kaolin minerals from felspar. Selected felspars of known composition have been subjected to attack by dilute hydrofluoric acid or carbonic acid under specific conditions of temperature and pressure, and the resulting alteration product studied by X-ray methods. The action of dilute hydrofluoric acid at about 225° C. on a potash felspar resulted in the formation of a kaolin mineral—kaolinite or dickite. The action of carbonic acid on powdered felspar did not result in the formation of any kaolin mineral. The authors consider that this

may have been due to the relatively short duration (156 hours at temperatures up to 60° C.) of these experiments.

Comparative Studies on the Physiology of the Iris.

J. Z. YOUNG (*Proc. Roy. Soc. Lond.*, **B. 112**, 776, Jan. 1933), after a comparative study of the iris muscles of different fishes, has come to certain important conclusions regarding their physiology. In Selachians of which Scyllium, Mustelus and Trygon have been chosen as examples for study, he has found that the sphincter iridis muscle is not under direct nervous control. A quite different result has been obtained in bony fishes like Lophius and Uranoscopus. The varied effects of drugs like adrenaline, acetyl choline, pilocarpine and eserine have been noted on the different muscles of the Iris.

Study of the Upper Ionised Atmosphere in Bengal.

PROF. S. K. MITRA and Rakshit have recently communicated the results of their study of the upper ionised atmosphere in Bengal by wireless echoes of short delay (*Phil. Mag.*, **15**, 20, 1933). The group retardation method as developed by Breit and Tuve has been employed with a transmitter of the type originally suggested by Appleton and Builder. From a knowledge of the time interval between the direct and reflected pulses reaching the receiver, the equivalent height of the upper F-layer has been calculated. The recording system, which is located at a distance of 3·8 km. from the transmitter, consists of a receiver and a cathode ray oscillograph. One pair of the deflecting plates of the latter are connected to the receiver output and the other to the neon tube oscillator for obtaining the linear time base. The height of the F-layer is observed to decrease gradually as the day progresses, the evening value being usually about 20% lower than the midday value. The average height of the F-layer in the afternoon is about 250 km. Multiple echoes become very conspicuous near sunset and their number increases as one moves away from the transmitter. Though no regularity in their relative intensity is noticed, the time intervals are absolutely constant thus supporting the hypothesis that echoes are caused by multiple reflection between the earth and the ionised layer.

Magnetic Properties of Wood Ashes.

E. WEDEKIND has recently investigated the magnetic properties of the ashes of a large variety of woods in the Forest Academy of Hannover Münden and his results have been published in *Naturwissenschaften*, **21**, 24, 1933. He finds that most ashes have distinct ferromagnetic properties, due probably to the presence of iron as magnetite. The magnetisibility is dependent on the strength of the magnetic field and even minute differences in the iron percentages have apparently quite a considerable influence. As all the woods that were investigated were grown on the same kind of soil, differences in the constitution of the same are eliminated. It was found that the magnetisibility decreases in the order : larch-pine-fir-Scots-fir-oak-beech-ash-alder-birch. The preparation of the ash from the wood was carried out by a uniform method and the temperature was not allowed to raise above 600°. Higher temperatures apparently decrease the magnetisibility by chemical or physical processes. The ashes, obtained thus, even show differences in the colour, etc.

It would be very interesting to find out why certain plants possess a higher absorption capacity for iron and what influence this factor has on the other properties of the wood obtained from them.

Abundance Ratios of (rare) Isotopes.

[H. Kallmann and W. Lasareff. *Zs. f. Phys.*, **80**, 237, 1933.]

BY means of some improvements effected in the mass-spectrograph (using an electrometer whose reading gives the intensity of the mass-spectrum line) the authors have determined the abundance ratio of O^{18} to be 1/630 of O^{16} while the intensity of O^{17} could not be measured. By comparison of their results in Neon with previous determinations they find that the intensity of a mass line does not depend on the conditions of discharge in their form of apparatus. This is important since there are variations of more than 100% in the intensity ratios of isotopes deduced from band spectra, due to variations in the conditions of excitation (see F. A. Jenkins & L. S. Ornstein, *Proc. Kon. Akad. Wet. Amsterdam*, **35**, 1212, 1932). Thus C^{13} : C^{12}=0·2 in stellar spectra, 0·005 in the furnace spectrum and somewhat larger in the Mecker flame and vacuum tube, but C^{13} does not at all occur in the arc. With

the new apparatus the authors find that $Ne^{20} : Ne^{21} : Ne^{22} = 93 \cdot 7 : 1 : 9 \cdot 75$. They have also found traces of another isotope of mass 23 whose intensity is 1/2000 of that of Ne^{20} and they think that the corresponding mass spectrum line must be due to a new isotope and not to $Ne^{22}H$, since such compounds do not occur in other rare gases. Working with HCl they find also another chlorine isotope Cl^{39} which is 1/1920 times as intense as Cl^{37}. Using negatively charged ions they found that $Cl^{39} : Cl^{37}$ as 1 : 1850. Hence the result, $Cl^{39} : Cl^{37} : Cl^{35} = 1 : 1850 : 6000$. Cl^{40} did not occur; if it exists at all it is less than 1/10000 of Cl^{37}.

Optical Orientation in Felspars.

A VERY interesting paper on "Permanent changes in the optical orientation of Felspars exposed to heat" has been recently published by F. W. Barth (*Norsk Geol. Tidsskrift*, **12**, 1931) and the following new data are furnished on this subject:

"Orthoclase frequently exhibits conspicuously large changes of the optic axial angle, whereas the position of the optic indicatrix remains unchanged. It was found to be a general rule that the more potassic the felspar the bigger the change.

Microcline is *not* changed by heat treatment. Since it has been claimed that microcline, if heated long enough, will slowly invert to orthoclase, it is worthy of notice that this assertion is proved to be false.

Albite and oligoclase are very slightly changed on heating.

Labradorite exhibits appreciable alterations of both the position and shape of the optic indicatrix."

Time-Variation of Gravity.

[Tomaschek and Schaffernicht. *Ann. d. Physik*, **15**, 789, 1933.]

ACCORDING to Couvoisier the cosmic motion of the earth should result in a diurnal variation of gravity by about 6×10^{-6} of its value, *i.e.*, by about $5 \cdot 9 \times 10^{-3}$ cm./sec^2. The authors describe a gravity meter which is claimed to be capable of detecting a variation of 10^{-9} of the value of gravity. A long spiral, about 18 mm. in radius and made of Krupp's elinvar steel wire of 0·5 mm. radius, is attached to a torsion head at the top and to a small pulley at the bottom. A rod attached to the pulley along its axis carries a gilded weight of 52·5 grm. The spiral weighs 12 grm. and when stretched by a weight of 52·5 grm. its length is 110 cm. The pulley is supported partly by a bifilar suspension of phosphor bronze, 43 cms. long, attached at the ends of a diameter. The torsion head can be rotated and its position can be read correct to 20″. It is also capable of being moved up and down to within 10^{-3} mm. so that the part p of the weight balanced by the bifilar suspension can be varied. By making p small and rotating the torsion head so that the pulley is in a position of critical equilibrium, the slightest alteration of the length of the spring is made to cause a rotation of the pulley. This rotation can be detected by means of a mirror fixed to the rod which carries the weight. This weight forms part of an attracted disc electrometer and the change of weight compensated by a potential of V volts is $0 \cdot 945 \times 10^{-11} gV^2$. The whole apparatus is enclosed in an evacuated vessel and an attached barometer and thermometer indicate changes of pressure and temperature amounting to 10^{-2} mm. of mercury and $7° \times 10^{-4}$ respectively. Automatic records of the motion of a spot of light reflected from the mirror clearly show the daily periodic variations due to the lunar tide and to the declination of the moon, but no effect of the nature predicted by Couvoisier's theory is observed. The expected value for this effect at Marburg was $3 \cdot 2 \times 10^{-8} g$ and could have been easily detected. The authors conclude that a Lorentz contraction of the earth cannot be detected even by its gravitational effects just as it cannot be made manifest by electrodynamic experiments.

Recent Researches on Vitamins.

A SURVEY of the latest researches on vitamins is the subject of a special article in a recent issue of *Nature* (**131**, 118, 1933). After drawing attention to Prof. J. C. Drummond's useful summary of the position (*J. Roy. Soc. Arts*, **80**, 949, 959 and 983, 1932), the reviewer draws attention to the more important findings of the past few months. There is increasing evidence to show that narcotine derivatives possess no antiscorbutic properties: on the other hand, the identity of the antiscorbutic factor in lemon juice with a hexuronic acid (ascorbic acid) is gaining support. It is now generally agreed that crystalline vitamin B_1 contains sulphur: the recent observation of Guha and Chakravarty that ultra-violet irradiated

adenine sulphate possesses the properties of that vitamin would appear to bring us nearer to its synthesis than ever before. Vitamin B_2 would appear to be a neutral substance with a higher molecular weight than vitamin B_1. The preparation of a crystalline compound with vitamin B_4 activity and an empirical formula $C_4N_4H_5Cl$ has been described. Karrer and his co-workers suggest that vitamin A is an unsaturated alcohol with the empirical formula $C_{20}H_{30}O$ or $C_{22}H_{32}O$, an observation which is supported by the work of Heilbron, Drummond and their co-workers. Owing probably to the presence of substances which interfere with the development of the blue colour, the Carr-Price reaction does not yield results which are in keeping with those obtained by biological methods. The intensity of the band at 3280 Å in the whole oil appears to be a very satisfactory measure of biological activity. The mechanism of the transformation of carotene into vitamin A is still obscure: the conversion occurs, presumably, in the liver but there is no evidence to suggest that it is brought about by an enzyme. Deficiency in vitamin A leads to increased nitrogen metabolism resulting in less nitrogen being deposited in the body and more being lost by excretion than when the supply of that vitamin is adequate. The growth-promoting and anti-infective properties of vitamin A are due to its ability to maintain a normal structure in the different tissues of the organism. The isolation of crystalline vitamin D has reduced the interest in biological tests for the antirachitic vitamin. Mention should however be made of the prophylactic radiographic method of Bourdillon and Bruce, bone analysis of Hume, Pickersgill and Goffikin, and analyses of 'line' test and growth-promotion studies of Key, Cowart and Morgan. The review ends with a suggestion that a dietary survey should be carried out to determine the extent to which the various minor diseases are traceable to deficient intake of vitamins. It need hardly be added that similar surveys carried out in the different provinces of India will lead to findings of considerable practical importance.

Method of Manufacturing a Leather Substitute.

[*Ind. Pat.*, No. 18519 dated 23rd November 1932.]

THE above invention by Seiichi Yamamoto, a Japanese engineer, relates to the utilization of the bark of *Arto carpus Kunstleri* known also by the name, 'Kayutarap' in the South Sea Islands. The bark contains a very strong fibre together with 8–12 per cent tannin. The latter is removed by either extraction or spontaneous fermentation: the residue is opened in a wet condition with a roller or by beating to make a coarse network. The clean fibrous product thus obtained is pasted together with couchoc or balata dissolved in a volatile solvent with sulphur, pressed and finally steamed for vulcanization. Boards of artificial leather are thus obtained which have a pleasing appearance, are flexible, elastic, water-proof and resistant to mildew and possess at the same time, high tensile strength comparable only with leather of best quality.

There are numerous trees and shrubs in India the barks or stems of which contain fibre of the desired quality. It is not improbable that some of them may be useful for manufactures similar to those claimed in the above patent.

Science News.

Mr. K. R. Venkatasubban, Science College, Trivandrum, has sent a note in which he records a case of abnormal strobilus of Lycopodium, section Phlegmaria.

* * *

Miss Oldroyd's note on "Liverworts and Fern Sporophytes" published in *Cur. Sc.*, **1**, 7. 216, suffers from the defect that the specific name of the plant is not mentioned. Rai Bahadur Professor Shivaram Kashyap and Mr. A. C. Joshi of Benares Hindu University draw the attention of the author that the specimen she has described is *Gymnogramme leptophylla Desv.* and that the observation she has made has already been recorded by previous authors.

* * *

MR. M. KRISHNA MENON, University Zoological Laboratory, Madras, writes:—

"Larvæ of Decapod Crustaceans form an important constituent of the plankton of the Madras coast. Large numbers of them belonging to most of the families of the order were captured soon after the rains. This abundance seems to be due to the fact that the adults begin to breed as soon as the rainy season has set in. Their number falls gradually towards the close of March and in April; but in the succeeding four months which form the hottest part of the year the fall is sudden and considerable. Further, it has been noticed that the larvæ occurring in the townet collections of these months belong mostly to Anomura and Brachyura. They occur also

during the other months so that they can be considered as fairly permanent constituents of the plankton. It would seem, therefore, that these larvæ are more hardy and better fitted to endure the variations in the physical and chemical properties of sea water during different parts of the year. Several Decapod forms, however, appear only for short periods, being practically absent during the rest of the year.

These general observations were made while I was engaged in 1932 in a detailed study of the larval histories of 4 forms, *viz.*, *Acetes sp.*, *Callianassa sp.*, *Hippa asiatica* and a form belonging most probably to the sub-family *Upogebinae*. The work has now been completed and is being published in the next number of the *Madras Museum Bulletin*. Further study of other Decapod larvæ will be taken up in 1933."

* * *

Aluminium and Zinc as Water Softeners.—DR. B. S. SRIKANTAN, D.Sc., Chemical Laboratories, College of Engineering, Guindy, Madras, writes:—

"It is found that aluminium powder and also mixtures of aluminium and zinc powders when shaken with hard water render it soft. Aluminium removes only the temporary hardness in less than two hours. Plenty of evolution of carbon dioxide takes place and a white precipitate is thrown down. It is not capable of removing permanent hardness. The reaction could be represented by

$$MgO, 2CO_2, H_2O + 4Al + 3O_2 + 6H_2O \rightarrow 2Al_2O_3, 6H_2O + MgO, H_2O + 2CO_2$$

Permanent hardness due to $CaSO_4$ and $MgSO_4$ is removed by mixtures of aluminium and zinc. A mixture of *Al* and *Zn* in the ratio of 1:10 was found to be the best. Hydrogen is liberated in this case. The reaction is perhaps due to the incipient electrolytic action of the *Al-Zn* couple resulting finally in the adsorption of the SO_4-ions on the surface of these metals.

In all cases hard waters with definite amounts of bicarbonates and sulphates of calcium and magnesium dissolved in them were prepared and examined. The *Al-Zn* couple is so effective that the resulting soft water fails to give the usual test for the radicle. A few of the results are cited here.

Hardness of water due to	Degree of hardness Before	After	Softener
$Mg(HCO_3)_2$	50·5	1·2	Aluminium
$CaSO_4$	61·6	1·0	Al–Zn.
$MgSO_4$	62·5	1·5	Al–Zn.

For Laboratory tests trials were made with 10 gm. of the softener and 2 litres of hard water. Technical details are being worked out."

* * *

Gall in the Mango Fruit.—Dr. T. R. SESHADRI and MR. G. SESHADRI IYENGAR, Agricultural Research Institute, Coimbatore, in the course of a communication, write:—

"Though the existence of galls in parts of the mango tree such as the stem, leaves, etc., has been frequently noticed and studied, there does not seem to be any mention in the literature about the occurrence of galls inside the mango fruit. A peculiar case of gall in the fruit was noticed in a variety called 'Neelam' fairly common in Coimbatore. It is a rather small sized fruit with a thick skin which is usually light yellow, the mesocarp also being of the same colour. It is sweet and non-fibrous. It is frequently found to be attacked by beetles and when the fruit is cut, one or more of them emerge from holes in the nut. The specimen herein described contained, however, no beetles and the nut was entire though very undersized and thin.

The gall was found to be in the form of nodules which were rather hard to eat and which filled most of the fleshy portion of the fruit. On making a hole at one end of the fruit and squeezing it, the thin nut along with a small quantity of fleshy matter come out. The gall remained inside and was found to be sticking to the skin fairly firmly.

The photomicrographs of the section of the gall reveal prominently the thickening of the cell walls and the existence of granular bodies inside the cells. From micro-chemical tests it is found that the cell walls are not made up of cellulose but that they are mostly cutinised with lignin-formation in certain of the highly thickened portions. The granules inside the cells consist of starch."

* * *

Mosquito and Charophyta.—MR. S. C. DIXIT, M.Sc., Wilson College, Bombay, writes:—

"There is a remarkable statement in the Presidential address of the Botany section of the last Science Congress published in *Current Science* (January, p. 208). It says: "It is reported that mosquito larvæ do not flourish in water in which Characeæ are growing. If this should prove to be correct, then we have another method of getting rid of the larvæ."

Recently Mr. B. P. Pal has discussed the same topic at length in his paper on Burmese Charophyta (*Linn. Soc. Jour.*, **49**, 327, p. 61). Mr. Pal says: "It is highly probable, therefore, that the supposed larvicidal properties of Charophyta are non-existent."

The writer has been working on Charophyta and his observations confirm Mr. Pal's results. Mosquito eggs are laid mostly in shallow and stagnant water irrespective of Charophyta. The problem should, therefore, be studied in relation to the depth, stagnation and the size of water-holding area.

At Santa Cruz near Bombay there are vast areas covered by Charophyta; yet this place is full of mosquitoes.

Larvicidal effect of Charophyta seems to be one of those fallacies wherein a scientist occasionally gets entangled."

* * *

At the Section of Mathematics and Physics of the last Indian Science Congress, Prof. S. K. Mitra read an interesting paper on investigations carried out at Calcutta on the ionised regions of the upper atmosphere in Bengal by wireless echo method. The results so far obtained indicate that (*a*) there are two distinct ionised regions, the so-called E- and F-layers, (*b*) there is a marked diurnal change in the heights of both these layers and in the intensities of the echoes therefrom, (*c*) the multiplicities of the echoes are most prominent during the sunset and sunrise periods, (*d*) the number and intensities of echoes increase as one moves away from the transmitter. The observations were carried out at various places within a radius of 8 km. from the transmitter, with a mobile receiver fitted up in a motor bus.

To demonstrate the observed results before a large audience, a cinematographic record of the echoes was obtained on a film. This was exhibited to illustrate the important features of the echoes. The oscillograph employed for filming was the

Cossor c-type and the camera was Zeiss kinema. The experimental portion of the work was done by Mr. H. Rakshit, M.Sc.

* * *

At the Annual General Meeting of the Indian Chemical Society, held on Tuesday, the 3rd January 1933, at Patna, the following office-bearers were elected for the year:—

President—Dr. N. R. Dhar, *Vice-Presidents*—Dr. H. E. Watson, Dr. J. N. Mukherjee, Dr. H. K. Sen, *Hon. Secretary*—Dr. P. C. Mitter, *Hon. Treasurer*—Dr. P. Neogy.

* * *

Under the auspices of the Mysore University, Prof. B. S. Madhava Rao delivered two extension lectures on "Recent Developments in Astrophysics". In the first lecture the galactic system, extragalactic systems, Shapley's recent cosmological scheme of galaxies, super-galaxies and meta-galaxies, all included under the general head of "space-time complex", were described, followed by an outline of the scheme of evolution as developed by Jeans and the theories of the origin of the solar system. In the second lecture recent theories of stellar evolution were detailed. The relation between luminosity and effective temperature leading to the importance and evolutionary significance of the Russel diagram, Eddington's pioneer work on radiative equilibrium, and the theories of Eddington, Jeans and Milne on Stellar Stability were then described. The relative merits of the three theories were argued and a strong case made out for that of Milne.

* * *

We acknowledge with thanks the receipt of the following:—

"Journal of the Indian Mathematical Society"—Vol. 19, No. 11, Oct. 1932.
"Indian Forester"—Vol. 59, Nos. 1–2.
"Chemical Age"—Vol. 28, Nos. 706–710.
"Nature"—Vol. 131, Nos. 3298–3301.
"Education in India in 1930–31."
"Scientific Indian"—Jan. 1933.
"The Nagpur Agricultural College Magazine"—Vol. 7, No. 3, Feb. 1933.
"Berichte Der Deutschen Chemischen Gesellschaft," 66 Jahrg. Nos. 1–2.
"Brooklyn Botanic Garden Record"—Vol. 22, No. 1, Jan. 1933.
Report of the Indian Chemical Society for the Year 1932.
42nd Annual Report of the State College of Washington, Agricultural Experimental Station, Pullman, Washington.
"Journal of Nutrition"—Vol. I, No. 6.
"Bulletin of the U.P. Academy of Sciences"—Vol. 2, No. 2.

Reviews.

THEORY OF HEAT. By Prof. Max Planck (translated by Prof. H. L. Brose), pp. viii+301. London: Macmillan & Co., Ltd., 1932. Price 12*sh*.

The book under review forms the last of the five volumes on theoretical Physics by Prof. Max Planck, the distinguished originator of the quantum theory. The great merit of the work lies in assigning in the scheme of physical thought a proper place to the science of heat in which the laws of Newtonian mechanics were found for the first time to give way to the principles of quantum dynamics. The book is entirely theoretical and makes no claim to deal with experimental physics. The exposition throughout the book is very lucid and masterly which is characteristic of Prof. Planck's writings.

The book is divided into four parts dealing with thermodynamics, conduction of heat, radiation, statistical mechanics and the theory of quanta.

The treatment of the subject of thermodynamics closely follows the plan adopted by the author in his well-known treatise on Thermodynamics which has been widely appreciated by scholars and is almost a classic on the subject. The narration and deduction of formulæ are nearly identical with that of the other treatise and the reader readily perceives the similarity on a casual glance of the book. Some less important portions not directly connected with heat have been omitted, while at some other places the treatment has been slightly condensed without in any way impairing the lucidity and the logic of the exposition. The argument has at few places been modified as in the proof of the principle of increase of entropy (pp. 63–65) which is preceded by an exposition of the nature of the temperature and entropy functions.

Part II begins with a discussion of the application of the laws of thermodynamics to the theory of heat conduction. It is interesting to find the application of the second law to this subject, but one would wish to see its consequences worked out further. Next follows the investigation of a number of mathematical problems on heat conduction. Unfortunately an error appears to have crept on p. 139 where in the 6th line there should occur 'reversible' instead of 'irreversible'.

Part III deals with the theory of heat radiation and follows the plan adopted by the author in his well-known book entitled 'Heat Radiation' (Warmestrahlung). In deducing Wien's displacement law the author

has started with the concept of entropy radiation and applies the laws of geometrical optics to the propagation of this entropy radiation. The deduction is logically very elegant.

Part IV deals with the statistical and the quantum theories of heat. It gives a very clear and logical account of the subject-matter leading up to the quantum statistics and Planck's law of distribution of energy. The last chapter deals briefly with the evaluation of the sum of states, the deduction of gas laws, chemical constant and connected topics. The chapter could have included with advantage accounts of the application of the quantum theory to specific heat of solids and gases, of Bose-Einstein and Fermi-Dirac statistics.

The book thus gives an authoritative account of the theory of heat leading up to the modern developments such as the quantum theory, statistical theory and quantum statistics. The exposition is very lucid and logical and the book will form a valuable addition to the literature on Heat in English.

M. N. SAHA.

* * *

TEXT-BOOK OF PALÆONTOLOGY. By Karl A. Von Zittel. Translated by C. R. Eastman, revised with additions by Sir Arthur Smith Woodward. Vol. II with 533 illustrations, pp. xvii+453. Price 30 shillings nett. Macmillan & Co., Ltd., London.

The second volume of Zittel's series of Text-books of Palæontology has been out of print for some years and its publication, revised and in many cases rewritten so as to incorporate many new discoveries made since the publication of the first English edition, will be widely welcomed. The original form of the book remains the same and the method of treatment adopted by the author is still preserved. This volume deals with vertebrates upto mammals which are treated in the third volume.

We have no hesitation in saying that the book is an excellent work of reference in the hands of experts, but we doubt very much if it can be used by the general student of zoology or for class purposes. It is really a systematic work with figures and illustrations useful for taxonomic purposes. The definitions and diagnostic characteristics might with great advantage have been rendered fuller so as to make the usefulness of the book more general. A uniform treatment of the several fossil groups is impossible of attainment unless our knowledge of them is as complete as that of living forms and a systematic work like that of Zittel's text-books can only be used with great caution and with obvious limitations by students of general palæontology.

The study of zoology is incomplete without a proper training in Palæontology and provision is accordingly made in the syllabuses of zoology for the inclusion of the study of fossil forms. The evidence furnished by the animals in remote ages to the evolutionary concept of life is indispensable to the teaching of zoology and viewed from this standpoint the book furnishes very few materials. For instance, the evolution of the caudal structures of fishes is an extremely fascinating subject; the inter-relationships of the vertebral elements in the different parts of the dorsal axis, and structure of the skull are other interesting studies which should have been discussed in the introductory section on Pisces. To students of zoology and general palæontology, the origin of pentadactyle limbs of Tetrapoda possesses great attraction and in the chapter on Amphibia, one would expect to find a reference to the numerous theories which have been advanced to derive the tetrapod limbs from the gill arches and fins of fishes. In the chapter on Reptilia the description of the vertebral column should have included a discussion on the evidence provided by the Stegocephalia and Proreptilia in regard to the difference in the development of the vertebræ in the groups Amphibia and Reptilia. Similarly the description of the atlas of crocodiles might have been made fuller by comparison with its structure in *Metrorhynchus* and *Sphenodon* and pointed out how the epistropheous has come to bear two ribs. There are several other subjects which could have been treated from the standpoint of comparative study and we have no doubt that such a treatment of the subject would have made the book an invaluable possession to students of zoology.

But for these details which certainly would enhance the value and usefulness of the book, we have a genuine regard for the excellent and lucid method of exposition adopted in the treatment of what is generally regarded as dry and uninviting portion of palæontology. The illustrations include old figures of actual fossils and several new ones have been incorporated, taken from the fourth German edition, besides diagrams from original papers. The bibliographies under different sections have been enriched

by the addition of newer literature and this is a source of great advantage to students working on any particular group.

The introductory chapters which are intended to be general introduction to the various classes give sufficient information for pursuing the study of the anatomy of the fossils comprehended under them. We welcome this English edition of Zittel as a great addition to our works of reference which will provide the necessary guidance and stimulus to all students interested not only in the study of palæontology but also in general zoology.

C. R. N.

* * *

VON DAVY UND DÖBEREINER BIS DEACON, ein halbes Jahrhundert Grenzflächenkatalyse. (From Davy and Döbereiner to Deacon; A Half Century of Contact Catalysis.) By Alwin Mittasch, and Erich Theis. Verlag Chemie G.m.b.H., Berlin, 1932. 278 pp. Price Mk. 18·50.

A history of chemistry may be of the descriptive type in which case it must suffer by the omission of many material facts or it may be encyclopædic and consequently somewhat disjointed and uninteresting. The authors of the volume under review have endeavoured to combine the advantages of both types by adopting a system of comprehensive foot-notes which occupy some 25 per cent. of the whole volume; the main text has in consequence a fair degree of continuity, but it is still to be noticed in many cases, that those pages with the fewest foot-notes afford the most pleasant reading.

There is no doubt regarding the encyclopædic character: the authors appear to have taken immense pains to let no reference to contact catalysis, however insignificant or obscure, escape their notice. Many little-known facts have thus been brought to light and curiosity aroused regarding the life and work of authors whose names are unfamiliar. It is only to be regretted that in a work of modest dimensions fuller details cannot be given.

As a description of contemporary thought and work the book is less happy. The most interesting chapters are those dealing with platinum and the synthesis of ammonia, as these are in the nature of a review of the ideas of all who were interested in these outstanding problems of their time. The remainder is somewhat disjointed, as is bound to be the case when a single subject is considered. The value of studying the lives of great scientists lies largely in following the line of thought which led from one discovery to another and in examining their methods of conducting experiments with the crude apparatus available. The authors have done what they can to bring in the personal element by the inclusion of illustrations, sketches of apparatus and occasional quotations but in spite of this there remains a feeling that something is wanting. The reason is undoubtedly the presence of so many references, but as these form an essential part of the work, it is evident that the failing is one that cannot be corrected. Too much attention should not therefore be paid to this aspect. The real value lies in the thoroughness with which the matter has been compiled and as a book reference for all who are interested in the history of chemistry and students preparing for examinations the volume can be highly recommended.

H. E. W.

* * *

LEHRBUCH DER ANORGANISCHEN CHEMIE (Text-book of Inorganic Chemistry). By Dr. Heinrich Remy. Akademische Verlagsgesellschaft m.b.H., Leipzig, 1931. Vol I, xxii+718 pp., 92 figs. Vol. II, xvi+450 pp., 32 figs. Price, Vol. I, RM. 20; Vol. II, RM. 14.

The most noteworthy feature of this new text-book is that in the small range of two volumes consisting of about 1,150 pages, the field brought under survey includes not only the whole of inorganic chemistry, but in addition the theoretical aspects of general and physical chemistry with their applications to special problems. The first volume deals with the elements of the sub-group A of the first three groups and the sub-groups B of the next four groups of the periodic table. The elements of a single family (*e.g.*, lithium, sodium, potassium, rubidium, caesium) are treated together in one chapter which presents at the outset the results of recent work concerning their general characteristics, such as normal potentials, ionic and atomic radii, crystal structure, compressibility and spectra, along with their methods of preparation and chief uses; the larger part of the chapter, however, is devoted to a descriptive account of their compounds. The second volume covers the elements not treated in the first volume and these include the transition groups and the rare earths, the method of treatment being similar to that adopted in the first volume.

Important considerations of theoretical chemistry such as Bohr's theory of the hydrogen atom, Kossel's theory of valency, X-Rays and crystal structure, and the co-ordination theory of valency, are dealt with very clearly in separate chapters in appropriate positions of the first volume. Although the usefulness of the book is unquestionably enhanced by this procedure, it is to be regretted that it has entailed the curtailing of portions dealing with preparative and analytical chemistry. The second volume, however, is free from this drawback and gives as full an account of the elements and compounds coming within its scope as is to be found only in much larger treatises.

The two volumes of this work form a valuable addition to the existing text-books of inorganic chemistry and are certain to prove of great use to students of chemistry in the honours courses of our universities as well as to lecturers on the subject.

K. R. K.

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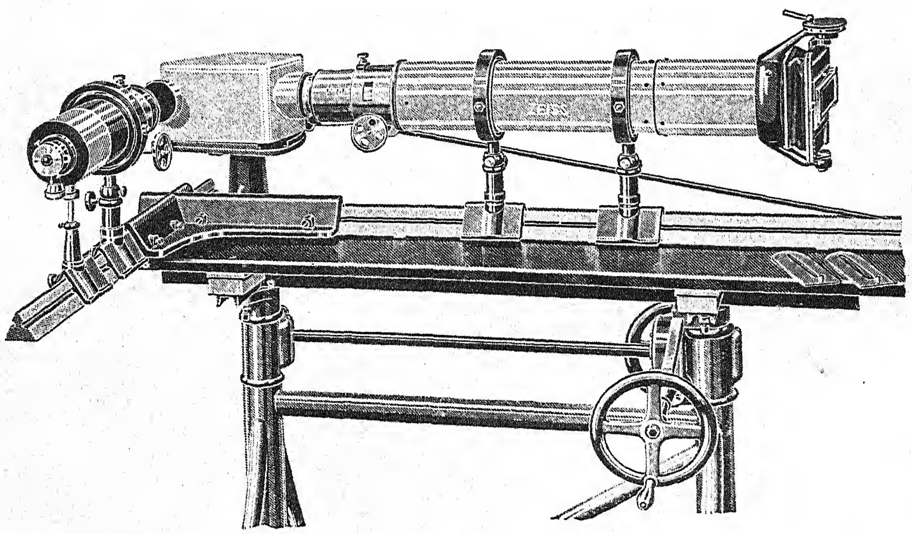

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CONTENTS.

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The Inter-University Board.

At the Quinquennial Conference of the representatives of Universities recently held at Delhi, a most notable pronouncement on the functions of the new type of Universities under the reformed constitution, was made by H. E. The Viceroy in his opening address, and perhaps the most important educational subject discussed by the delegates at their sessions was the desirability of instituting the vernaculars as a medium of instruction and examination in the non-language branches of knowledge in the pre-university course. A suggestion is reported to have been made quite seriously by one of the delegates representing one of the S. Indian Universities, that even the higher education in science and humanities should be given in the vernaculars. Almost immediately after the Conference concluded its sittings, H. H. The Gaekwar of Baroda who presided at the Hindi Sammelan which also met at Delhi spoke in favour of adopting Hindi as the *lingua franca* for India and Sanskrit as a common script for the whole country.

It seems to us that there is a wide difference between the development of one's own vernacular and the adoption of Hindi as a common language for the whole of India and we are fully aware of the fact that language barriers impose serious obstacles in the way of attaining national solidarity. We are disposed to think that the failure of the World Economic Conference which was attended by representatives of nearly sixty-six nations who assembled in London, some time ago, is largely to be attributed to the inability of the delegates to understand each other's sentiments without the assistance of interpreters. Each delegate treated the world problem from the standpoint of his country and offered proposals for its solution in his own language. It is obvious that narrow parochialism of language and outlook must surely militate against unanimity of agreement being reached in arranging for a common policy or the treating of the world economic question as an organic unit. In a sense, India is like the powers participating in the World Economic Conference and the very causes which led to the collapse of the latter, also operate against the attainment of the national aspirations of the former. In order to produce linguistic unity among the Indian people,

H. H. The Gaekwar has suggested the following solution:

"For imperial affairs English, for the higher cultural life English and Sanskrit, for national life Hindi, for home-life our vernaculars—such is, I think, India's immediate path."

In another section of his speech, His Highness while criticising some South Indian leaders advocating English as the common speech for all India, is reported to have said:

"We have, in other words, to imagine every Indian as trilingual, with one tongue for his home and social life, and another, English,—totally unrelated,— for his public and interprovincial communications. To these he must add Sanskrit if he is a Hindu, Arabic or Persian if he is a Muslim. These are needed if he is not to be alienated from his own literary heritage. Thus with his every-day mind working in, say Marathi or Bengali, he must have an English lobe and a Sanskrit or Persian lobe to his brain for his pursuit of his eastern and western culture."

We are afraid that the constructive proposals of H. H. which we have already quoted tend rather to increase than to diminish the number of lobes against which he complains. If the criticism is true that the present bilingual system of education in India deprives its recipients of the ability to think clearly in either of the languages, then if we were to multiply the languages in accordance with His Highness's suggestion, thinking will perhaps come to be regarded in India as an idle waste of thought; much less would such a procedure confer on young men the power to enrich their literature in any one of the languages enumerated by His Highness. His suggestion, however, is capable of simplification without injuring its great merits.

The history of the vernaculars in the Indian educational system is interesting, and recently the whole problem has undergone a complete change and has assumed a new complexion which the earlier advocates of vernaculars could not have pictured to themselves. It may be remembered that the abolition of Persian from the courts in 1837 and the freedom conferred on the press gave a great impetus to vernacular education. In the subsequent year Sir Charles E. Treveleyan wrote: "We are deeply sensible of the importance of encouraging the cultivation of the vernacular languages and we conceive the formation of a vernacular literature to be the ultimate object to which all our efforts must be directed." Almost every educationalist or administrator who has spoken or written on educational subjects since that date has referred to the need of cultivating the local vernaculars so that they may be used as a means of conveying to the masses of population the advantages of western scientific knowledge and culture; but in 1904, the Government of India discovered that in the intensive pursuit of acquiring efficiency in English, the Indian pupils had neglected their vernaculars almost to a degree. In reviewing the causes which led to the neglect, the Government of India in their Resolution of 1904 suggested the employment of the vernaculars as a medium of instruction up to the age of thirteen. This question of the medium of instruction was again raised by Mr. Rama Rayaningar (Raja of Panagal) in the form of a motion in the Imperial Legislative Council in 1915. Thus the general review of the causes which led to the vernaculars being neglected, introduced into education a totally different problem, *viz.*, the medium of instruction and since 1915, other considerations than those of a purely educational character have tended to render the whole subject exceedingly complex.

The justification for introducing the vernacular of the pupils as the medium of instruction up to a certain age is now recognised beyond dispute but the argument that it is the only medium by which education can progress in India even in the higher grades is not borne out by the testimony of earlier educationalists. The Public Education Committee of 1831, of which Sir Charles Treveleyan was a member, in reviewing the results of education, have recorded that "a command of the English language and a familiarity with its literature and science have been acquired by the pupils to an extent rarely equalled by any schools in Europe. A taste for English has been widely disseminated." Seven years after the publication of this report, Sir Charles Treveleyan commenting on the capacity of Bengalee children for learning English, says that they "seem to have their faculties developed sooner and to be quicker and more self-possessed than English children. Even when the language of instruction is English, the English have no advantage over their native class-fellows. As far as capability of acquiring knowledge is concerned the native mind leaves nothing to be desired. The faculty of learning languages is particularly powerful in it." The allegation that the use of a foreign language as the medium of instruction in Indian schools and colleges must result in the "mental degradation" of

the pupils, is not applicable to the present generation of scholars, scientists, philosophers, public leaders and economists nor even to the critics of the educational system.

The educational plan as devised by the Resolution of the Government of Lord William Bentinck was to educate the upper and middle classes first and through them, the great masses of people and for this purpose, successive governments emphasised the cultivation, refinement and enrichment of the vernaculars. The modern reformers of education desire to reach the masses of the people directly by making their mother tongue the medium of instruction, and undoubtedly this is a measure of reform which is bound to have great influence on the social and ideal life of the people. Among the reformers who advocate a change in the medium of instruction we may recognise three distinct schools of thinkers. A large section of people most sincerely feel that the substitution of Hindi as the medium of instruction in all grades of education is a reform urgently called for and they certainly have very weighty arguments in favour of their proposals. But under this scheme the rural population inhabiting the non-Hindi provinces will continue to suffer from the very disabilities which English as the medium of instruction has imposed. The second school of thinkers, who see in the development of the local vernaculars the mechanism for improving the social and economic system of the people, support the adoption of the language of the provinces as the medium of instruction only up to the high school standard and in accordance with this recommendation, the local governments, through their educational departments, have accorded permission to the high schools to teach non-language subjects through the vernaculars. A small third section of educationalists hold the opinion that, while English should be permitted to remain as the medium of instruction in the high schools, every encouragement should be provided for the cultivation of a sound and efficient vernacular prose literature and the infusion into it of the elements of modern culture.

Within comparatively recent years the major Indian vernaculars have developed to a sufficiently high pitch to be used as the medium of instruction in general subjects at least up to the pre-university course, but the competing claims of any one of them to be selected as the exclusive language for the whole of India will raise difficulties of a non-educational character. Every student of contemporary educational thought, knows that there is an extensive and authoritative body of literature on the subject of the following resolution which the Universities Conference discussed at their last session:

"While this Conference favours the extension of the course of study for Degree Examinations to over three years instead of as at present, at the same time it is strongly of opinion that it would not be desirable to add one more year to the ordinary pass degree course, or to reduce the period of study for Degree Examination from four years after the high school stage to three, unless and until the standard of instruction in secondary schools is materially improved and that in order that the period of study for the pass degree should be at least three years, the total period of instruction of the pupil should not be increased but should be divided into definite stages of primary and middle in which stage education in non-language subjects should be entirely through vernacular wherever practicable and university education covering five (or four), four (or five) and at least three years respectively, there being a formal examination at the end of each stage, only thus avoiding abuse of too many formal examinations; that until this reorganisation is effected the total period of study of the pass degree should not be reduced to three years after instruction from the present four years."

It will be noticed that the recommendation of the Conference on the adoption of vernaculars as the medium of instruction makes it optional and other topics are treated in a conditional way.

A great part of our economic miseries arises from the faulty system of education which practically trains young men for unemployment, and almost all our political troubles are to be traced to the language barriers which separate the governing classes from the masses of population. It seems to us that in India the question of the medium of instruction extends beyond the frontiers of education; and if this is admitted, then a formula must be invented to remove the language anomaly which divides the government and the people. Recent experiences of the Government of India must have taught them the utter futility of the political doctrine first promulgated by the Court of Directors, that the masses of a vast sub-continent could be governed through "interpreters" and it is only natural that some of them should have now changed their calling. If the treatise submitted by Mr. Charles Grant to the Court of Directors had stipulated that every British sojourner in India for whatever purpose, should possess a working knowledge of one of the major languages of the

province and that his children should be educated along with those of Indian people, or if such a policy had formed one of the articles of the Great Proclamation, India would have been assured of two things. Firstly, the ruling classes would have established a language kinship with the people and secondly, Indian schools and colleges would have occupied the status now enjoyed by the Colonial institutions. It seems to us therefore that the question of the medium of instruction in schools and colleges is at bottom a question of the medium of language through which the government of the Indian people is to be administered and that the smoothness and stability of this administration must largely depend upon the degree of cordiality which a common language can promote.

If we accept a broad conception of the citizenship of the British Empire and admit that the British rulers in India form an integral part of its larger life then all educational reforms must bear some reference to the children of the European residents in India. The omission of this in the past has emphasised the difference now separating the governing classes from the Indian people and may possibly have contributed to much of the unhappy misunderstanding. If the Government of India were to arrange to educate the children of their officers in Indian educational institutions, along with children of the Indian people, than which nothing can be more desirable and natural, a great impetus would thereby be given to the progress of Indian education and the status of Indian schools and colleges. Is it not legitimate to demand that the children of the ruling classes, European as well as Indian, be trained along with those of the masses of population whose interests, needs, aspirations and difficulties they will in later life need to watch and study at close quarters and discuss in the vernaculars of the district when placed in positions of trust and authority over them? All Governments which choose to be isolated from the people by language barriers, and which base their administrative acts and measures on the testimony of interpreters, must inevitably live in an atmosphere of unreality. Racial exclusion must breed the suspicion which is the parent of all mischief, and we feel that the scheme of education that we suggest may produce happier results than any educational reform has so far conceived or attempted to produce.

The medium of instruction is intimately associated with the problem of employment. Whatever may be the medium ultimately adopted by Indian educationalists and statesmen, we should not ignore the fact that the recipients of such education must become fully qualified for all the rights and privileges of citizenship of the British Empire. Further, the medium must not impose a handicap on enterprising young men seeking to earn a livelihood in other parts of the British Empire. Keeping in view this aim, we shall have to devise a scheme of education in which the medium of instruction will bring the provinces nearer to each other, and the Government and the general population into closer bonds of mutual appreciation, sympathy and common endeavour; so that eventually the existing linguistic, social and racial barriers are removed. In India no system of education which does not emphasise the principle that the governing classes, no less than the different peoples should be Indians in thought, action and being, can be psychologically correct or practically sound.

Manifestly, the cardinal feature of such a system of education must be that every one in India ought to be able to speak one major language fluently and idiomatically besides his own. This implies that the ruling classes must acquire a deep knowledge of either Hindi, Bengali, Urdu, Marathi or one of the Dravidian languages to enable them to dispense with the assistance of interpreters in discharging their executive functions, administering justice in the countryside or discussing with the people the intentions and purposes of the Government acts and legislative measures. In future reforms of educational organisation provision must therefore be made for the training of young British Officers no matter to what branch of service they may belong as also their children and those of other European settlers in India, in one of the major provincial languages at least up to the intermediate standard.

The rural population, on the other hand, must have facilities, according to our scheme, of completing education at least up to the secondary standard in completely equipped vernacular high schools. And once the British administrators have realised the importance of learning the Indian languages more intimately than their "official tests" then what should be the medium of instruction for the upper and middle classes of

Indian children is clear. We have no hesitation in saying that English should be the medium in the Universities and Hindi or preferably Urdu in the High Schools. To us it seems that, if reduced to this simple form, the suggestions of the Gaekwar of Baroda must before long become the declared object of the educational policy of the Indian people themselves. It is almost impossible to imagine that the rapidly growing millions of India can ever be English-speaking. But it is not too much to suppose that the British administrators can become vernacular-speaking.

We are aware that this ideal must be somewhat remote for various reasons, the chief of which is that languages are among the most cherished vested interests of the people. We hope that it may nevertheless be fulfilled soon, since it calls for no sacrifice, but only for additional achievement. We have to realise that even in the ordinary affairs of life we find it difficult to become friendly with those with whom we cannot converse in their own language, whose habits and manners we have no means of understanding and whose literature we cannot read. The removal of such barriers must produce an atmosphere fostering friendship and peace, and will dissipate the misunderstanding and unhappy relations engendered by ignorance. We urge that in a case where the interests of a vast Empire are involved no effort which tends to consolidate the Government and people into an organic unit should be considered too great or beyond the resources of wise and far-seeing statesmanship.

Flow Beneath Masonry Works Founded on Sands.

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A COMMON characteristic of the Headworks of a number of canal systems in the Punjab and elsewhere in India is the construction of a weir across the river and a system of gates regulating the supply to the canal. The weirs that have been constructed usually rest on the sand beds of rivers and their stability largely depends on the flow of water under the weir and the pressure on the work due to the head of the water above the weir. Studies of the conditions of flow under the weir and of the pressures involved are therefore of the greatest importance both in connection with the design and stability of the work. A series of investigations on the above subjects has been in progress at the Irrigation Research Institute, Punjab, during the past year and although these are not by any means complete, the results are of interest as they indicate that theories of design which have been previously accepted are incorrect and that problems that were not suspected in the past require solution. A brief account of the work that has been done and the results obtained will be given.

The first step in these investigations was to devise a method of tracing the flow under a model of a work. After a number of trials the following was the method adopted. A tank was constructed of the following dimensions: $3' \, 10'' \times 2' \, 6'' \times 2''$. The tank was partially filled with a graded sand and the model placed in position on the sand. A solution of potassium chromate was then placed in the tank and after a certain period, usually six hours, the sand had become completely saturated with this solution. Upstream of the work a series of tap funnels was placed in position from which it was desired to trace the flow. The tap funnels contained solutions of silver nitrate which on entering the sand reacted with the potassium chromate along the lines of flow and so traced the lines of flow from the series of points.

The steel back of the tank carried a large number of pressure points which were inserted in the sand. The pressure points communicated with a series of manometer tubes and so the pressures under the work could be determined at the same time as the streamlines were being traced. The series of models investigated commenced with the simple forms of impervious floor and a sheet pile. Later more complicated combinations of these structures were investigated.

Fig. 1 shows the streamlines traced under a model of an impervious floor protected by upstream and downstream aprons and upstream and downstream sheet piles.

In the space available it is not possible to give the data on which the conclusions have been based nor is it possible to discuss fully the differences between formerly accepted views and the conclusions to be drawn from these investigations.

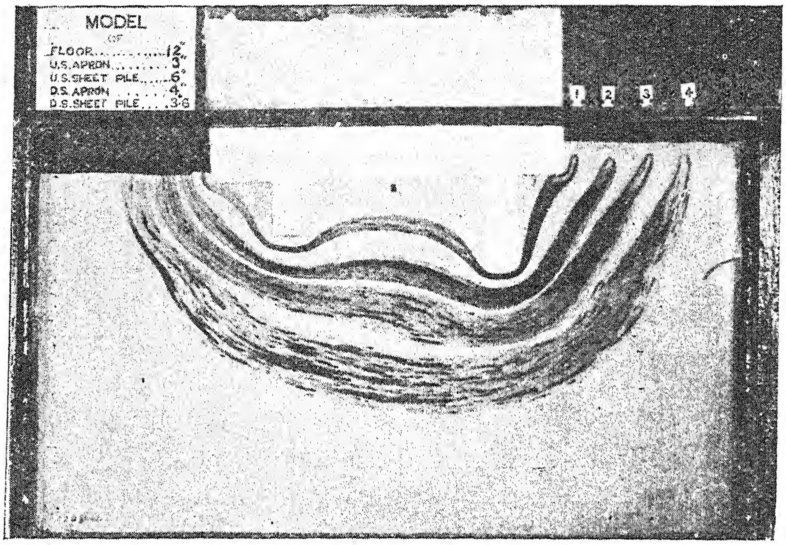

Fig. 1.

Until these investigations had been undertaken, very little data was available upon which theories of flow under a weir could be based. In fact, the accepted views were more in the nature of hypotheses than theories. The main hypothesis that had been accepted by Engineers was that of Bligh which can be stated as follows :—

"The main determining factor in the stability of the sand is the length of percolation or so-called 'Creep'. If an impervious line of sheet piles be inserted below the floor the line of creep may be measured down one side of the vertical obstruction and up the other side. The added length of creep will then be twice the length of the piling."

A further hypothesis regarding the flow is that due to Forchheimer. From a theoretical treatment of this subject he deduces that the flow under a floor should be in the form of a series of semi-ellipses symmetrical with reference to the floor. Since the streamlines cut the equi-pressure lines orthogonally, it follows from this that the pressure distribution should also be symmetrical with reference to the model. The results of the present investigation have shown that the creep which was imagined to take place by Bligh is not existent. Instead of the flow following the profile of the work it follows a series of curves determined firstly by the profile and secondly by the nature of the material, such as clay bands which may underlie the work at some distance from the surface. In any model composed of a floor and a system of sheet piles there appear to be two divisions occurring in the flow nearest the work. The first of these divisions is the major line of flow, the second is the diffused flow of very low velocity situated between the line of major flow and the work. One of the main effects of a system of sheet piles is to break up the flow into these two portions so that the velocity of flow near the work is very low and, hence, the work becomes stable from this point of view. The most stable form of work appears to be that illustrated in Fig. 1. The least stable form so far investigated appears to be an impervious floor protected by an upstream sheet pile. In this latter case there was a concentration of flow at the downstream end of the work which leads to instability owing to the velocity of the exit of the water being sufficiently high to cause the blowing of sand.

Possibly of greater importance than the actual flow of water under the work are the pressures under the floor. So far the investigation of the pressures has been mainly confined to those existing on a simple impervious floor. The results have raised a number of points not previously suspected and until the mathematical analysis of the results has enabled a theory to be put forward which covers the flow under these simple conditions it seems useless to investigate more complicated forms.

Up to the present time the examination of the pressure observations under a simple floor have led to the following conclusions :–

(1) The flow under a simple impervious floor is a series of semi-ellipses.

(2) The ellipses are not symmetrical with reference to the geometrical centre of the model. This fact invalidates the theoretical treatment of Forchheimer.

(3) The equi-pressure lines are not symmetrically distributed with reference to the geometrical centre of the model. They appear to be symmetrical with reference to the equi-pressure lines representing approximately 44 per cent. loss in head. This is again not in accordance with Forchheimer's deductions. Fig. 2 shows the type of pressure distribution observed.

(4) There appears to be a relatively large loss in pressure when the water enters the sand upstream of the model.

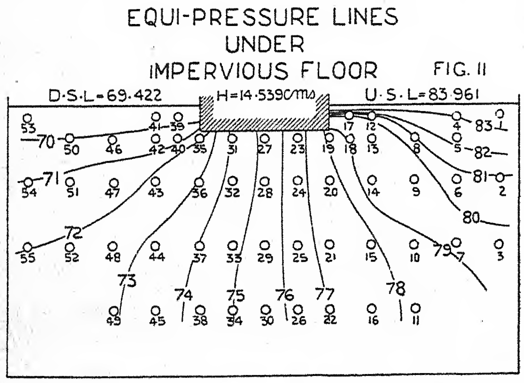

Fig. 2.

It is impossible at this stage to give a complete mathematical treatment of these results. Further experiments are now in progress with the object of studying intensively the pressure variations at critical points under the model. Until these results are available the conclusions already set forth cannot be amplified.

Although this work has only been in progress for about six months it has already found applications to engineering works. The first work to be studied was in connection with the repairs and reconstruction of Khanki Weir, the Head-works of the Lower Chenab Canal, Punjab. The first repair undertaken was the driving of sheet piles at the upstream end of the impervious floor in certain bays. From a study of a model of this construction it was forecast that the bays which had been so treated were in a less stable condition than they were originally before the repairs had been effected. Such proved to be the case, as portions of the floors of Bays Nos. 3 and 4 were damaged during the Kharif Season of 1933 shortly after the forecast had been made. During the cold weather of 1933-34, further reconstruction of the weir was undertaken and at the request of the Chief Engineer models were examined to determine the effects of the proposed measures.

It was shown that the proposals would result in a low velocity of flow in contact with the work but that owing to the presence of cavities under the upstream portions of the work the Hydraulic Gradient would be very steep in this region. The upstream portion of the work would, therefore, tend to be unstable.

In this connection the effect of the pressure relief pipes through the floor, which are a common feature of some works was also investigated. The pressure relief pipe normally installed just passes through the floor. It was shown that pressure relief pipes of this type resulted in the removal of sand from under the work resulting in the formation of the cavities which endangered the stability of the floor and was particularly dangerous because the damage was not open to inspection. In continuation of this investigation the effect of a tube-well, the strainer portion of which was situated some considerable distance beneath the floor, was examined. It was shown that the tube-well effectively relieved the pressure without endangering the stability of the sand. Tube-wells are now being installed in the floor of Khanki Weir where damage may occur through the presence of springs.

In the foregoing account an attempt has been made to indicate the nature of the new developments which are taking place in the

study of one aspect of hydraulics as applied to engineering works. The study at present is very incomplete but its importance is shown by the fact that the results have already found practical application at this early stage of the investigations.

The Occurrence of Crossing over in *Nicotiana* Species Hybrids.

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NUMEROUS trigenomal species hybrids were produced by crossing the F_1-hybrids with a third species or with the parental forms. They offer a very rich cytogenetic material which will be here considered in connection with the exchange of parts between the chromatids of the presumably homologous chromosomes of the species crossed.

The first meiotic division in *Nicotiana* is the reductional division. The univalent chromosomes in the hybrids and in the haploids are distributed at random to the two poles during the first meiotic division and divide during the second one. Exceptions, *i.e.*, division of univalent chromosomes during the first meiosis, occur so rarely that they can be neglected. We have observed such only in the haploid *N. Langsdorffii* (one chromosome has divided in 0·1% of the pollen mother cells) and in the hybrid *N. tabacum* ($n=24$) × *N. glauca* ($n=12$), in the latter, the dividing chromosomes being less frequent (Kostoff 1929, 1930).

In a great many *Nicotiana* species hybrids gametes are formed with the somatic number of chromosomes (unreduced) originating from restitution nuclei (Rosenberg's term). Some of the lagging chromosomes on the spindle in the hybrids do not succeed in reaching the poles during the I meiosis and form a bridge between the two poles, so that all chromosomes (somatic number) undergo interkinesis altogether forming one restitution nucleus. Second divisions with only one metaphase having the Somatic chromosome number of the plant have been often observed in the hybrids where restitution nuclei are formed at the end of the first division. The number of such metaphases is approximately as high as the number of the dyads formed. The number of the large pollen grains formed is about two times greater than the number of the dyads observed. Formation of equal dyads following fusion of both spindles during the second division has been very rarely observed. (This abnormality in meiosis leads to the same result as the formation of restitution nuclei.) Therefore the unreduced gametes formed during the meiosis in *Nicotiana* species hybrids usually result following non-occurrence of the reduction division.

The hybrid *N. glauca* ($n=12$) × *N. Langsdorffii* ($n=g$) represents one of the best examples in this respect. In this hybrid numerous unreduced gametes are formed following non-occurrence of the reduction division. The chromosomes of *N. Langsdorffii* conjugate with 9 chromosomes of *N. glauca* so that 12 chromosomes (9^2+3^1) have been usually observed during the first metaphase. The bivalent chromosomes disjoin during the I anaphase but the separation is often very much retarded so that restitution nuclei are formed, the chromosomes undergoing interkinesis in one group. Following such an interkinesis all chromosomes (12–*glauca*+9–*Langsdorffii*=21) appear in one group of 21 during the second division, *i.e.*, second metaphase with one spindle and one metaphasal plate with 21 chromosomes is formed. Then the equational division follows, so that dyads (instead of tetrads) are formed, each one having 9–*Langsdorffii* chromosomes and 12–*glauca* chromosomes or altogether 21 chromosomes. These chromosomes have been formed as chromatids during the prophasal stage of the I meiotic division. If there was no exchange of segments (parts) between the conjugating *glauca* and *Langsdorffii* chromosomes during the meiosis, the unreduced gametes thus formed should be identical, *i.e.*, they should have the same genetical constitution. If there was an exchange (or exchanges) of parts of *glauca* and *Langsdorffii* chromosomes, the unreduced gametes formed should not be genetically identical. They should differ one from the other by a series of genes. Finally, if there was an exchange (or exchanges) of parts between the chromosomes (but not between the chromatids) of the parental species the unreduced gametes of one dyad should be identical, but the

unreduced gametes of a whole hybrid should not be identical. They should differ by a series of genes.

We can easily find out whether the unreduced gametes produced by a hybrid are identical or different when we cross the hybrid back to the parental species or to a third species, provided that the parental forms or the third species, used in such a crossing are homozygous. If uniform trigenomal hybrids are produced from such a cross, the unreduced gametes formed in the F_1-hybrid are identical, if the trigenomal hybrids thus produced are not uniform, the unreduced gametes are genetically different.

In testing the uniformity of the unreduced gametes formed in *Nicotiana* species hybrids, we crossed the latter with homozygous parental forms or with a third homozygous species. We separated the trigenomal hybrids from the chromosomal aberrants among the offspring produced by detailed cytological investigations. Some of those that contribute definite data for the problem here investigated will be considered.

1. From the cross F_1 (*glauca* × *Langsdorffii*) × *Langsdorffii* 32 trigenomal hybrids with 30 chromosomes were produced, *i.e.*, 21 chromosomes (12+9) from the unreduced gametes of F_1-hybrid and 9 from the paternal plant *N. Langsdorffii*. Eleven of the trigenomal plants differed morphologically very distinctly from the other 21 plants, the latter being approximately uniform. These 11 plants differed in various ways from each other and from the other 21 in respect to several characters, as the shape and the size of the leaves and flowers, the length of the styles, the colour of the pollen, the colour of the flowers, the growth potency, the length of the vegetation period, etc. Some had two outstanding characters, others had three or four, etc.

2. Some of the plants of the trigenomal triple hybrids (*tabacum* $n=24$ × *sylvestris*, $n=12$) × *Rusbyi*, $n=12$, with 48 somatic chromosomes that were recently produced, also differed. It should be mentioned here that the chromosomes of *sylvestris* have a very great affinity to *tabacum* chromosomes and usually 24 chromosomes (12^2+12^1) have been seen in the plates of the first metaphases.

3. Each one of the trigenomal triple hybrids with 48 somatic chromosomes produced by crossing the hybrid *N. tabacum* ($n=24$) × *N. tomentosa* ($n=12$) with *N. Rusbyi* ($n=12$) has one genom from *tabacum*, one from *tomentosa* and one from *Rusbyi*, nevertheless they differed morphologically. The 12 *tomentosa* chromosomes conjugate readily with 12 of the 24–*tabacum* chromosomes in the F_1-hybrids.

4. Some of the trigenomal plants with 48 somatic chromosomes produced by crossing the hybrid *N. tabacum* × *N. tomentosa* back with *N. tomentosa* also differed morphologically.

5. There were some morphological differences between the trigenomal back crosses produced by crossing *N. rustica* ($n=24$) × (*rustica* × *paniculata*, $n=12$), (*rustica* × *paniculata*) × *paniculata*, and (*rustica* × *paniculata*) × *rustica*...It must be here also mentioned that the chromosomes of *N. paniculata* conjugate readily with the chromosomes of *N. rustica*.

6. Some of the differences observed amongst the trigenomal triple hybrids *tabacum* × (*sylvestris* × *Rusbyi*) may belong to the same category, but perhaps not all of them, because we found conjugations only between a few of *sylvestris* and *Rusbyi* chromosomes; most frequently, however, univalents have been observed during the metaphase of the meiotic division. Other factors that are probably involved in the processes responsible for the polymorphism of the trigenomal triple hybrid *tabacum* × *sylvestris* × *Rusbyi* will be discussed elsewhere.

We shall mention once more that in all species crosses here reported we have used species morphologically uniform (giving uniform progenies) with which we have worked during the last 8 years.

The differences observed in the trigenomal hybrids of 2, 3, 4, 5 and 6 are like those discussed in 1, *i.e.*, involving not single characters but several.

We shall also mention here that the three plants (*tabacum* × *sylvestris*) × *tomentosa* produced recently by Eghis differed morphologically. He did not use F_1 (*tabacum* × *sylvestris*) for maternal plant but an amphydiploid *tabacum* × *sylvestris*. Having in mind the very great affinity between the *sylvestris* and *tabacum* chromosomes, there is to be expected a formation of tetravalent chromosomes in the amphydiploid *tabacum* × *sylvestris* during the meiosis as this occurs in the amphidiploid *rustica* × *paniculata* studied recently, therefore an association and crossing over between the *tabacum* and *sylvestris* chromosomes in the amphidiploid *tabacum* × *sylvestris* is not excluded. But when we consider that in

separation of the four members of a tetravalent chromosome TTss (where T=*tabacum* chromosomes and s=*sylvestris* chromosomes) there may be two possibilities (supposing that T=T and s+s genetically), namely: Ts+Ts and TT+ss as these seem to occur in the *rustica*×*paniculata* amphidiploid [rrpp=(1) rr+pp, (2) rs+rs], then the differences in the gametes formed by the amphidiploids can be due not only to crossing over, but to the differences in whole chromosomes too.

The above examples show that the unreduced gametes formed in the F_1–species hybrids are not identical and their genetical differences can be most satisfactorily explained by postulating the occurrence of crossing over between the chromatids of the chromosomes of the parental species during the meiosis in F_1.

The differences among the trigenomal plants recorded above remind of those that are characteristic for the "mutant forms" in *Oenothera* "species" where not single characters, but a series of characters, are usually involved, in other words in these "mutations" obviously more than one gene are involved. Perhaps, it would not be right to call them "mutations", nor structural hybrids (as the *Oenothera* "species"). The term "cross-over-forms" may be more suitable for them.

It is quite possible that some of the differences observed in the trigenomal hybrids may be due to certain translocations, inversions, or to some other phenomena of these kinds, but we must add that such phenomena usually occur very rarely. Therefore the most probable cause for the differences in the trigenomal species hybrids is undoubtedly due to the occurrence of crossing over between the chromosomes (specially the chromatids of the maternal and paternal species).

There must be drawn a sharp line between the cross-over-forms and the gene mutations that may occur following hybridisation. The latter seem to appear (and can be expected) not so frequently as the former. Gene mutations can be distinguished with great difficulty from the segregations following hybridisation. We can be sure we have found a gene mutation following hybridisation when we see some recessive forms among the progeny of F_2– or subsequent generations of the hybrids of homozygous parents with dominant characters. The mutation rate among such progeny must be compared, of course, with the mutation rate of the parental forms. Such a case we have observed in *Capsicum*, where from crossing of two homozygous red peppers (red fruit) an F_2-generation has been produced with 1·37% plants having orange fruits when ripe. No mutations have been found among the progeny of parental forms. Another case that should be mentioned here is that in rye. Some of the F_1-hybrids produced from homozygous *Secale cereale*×*montanum* (concerning the presence of chlorophyll) gave in the F_2–generation various percentages of albinos. The albinos produced by Vavilov and Jakushkina in the F_1-generation after crossing *Triticum persicum* with other wheat species do not seem to belong to these categories. Their nature will be discussed elsewhere. But the occurrence of 1·74% white flowering plants in F_2 (*Aquilegia vulgaris*×*chrisantha*) (the former has violet flowers, the latter yellow) studied by Skalinska, seem to be due to gene mutations following hybridisation. The appearance of white flowering *Medicago* in the F_2-generation of the cross *M. sativa*×*falcata* (the former has violet flowers, the latter yellow) can be interpreted on the same basis.

The occurrence of recessive gene mutations in species crosses does not lead only to a degeneration of the organisms ("*reductio ad absurdum*" in Batesonian sense) when treated from an evolutionary point of view, because (1) the appearance of dominant gene mutations may occur parallel with the occurrence of the recessives, but we cannot separate the former so easily as the latter from the recombinations, and (2) it is quite possible that recessive gene mutations may serve as a source for the dominant genes when certain gene modifiers are involved in the way Fisher suggested in his theory of dominance.

From the data here presented we may conclude that crossing over occurs between the maternal and paternal chromosomes in the species hybrids, a process that conditions the manifoldness of the trigenomal species hybrids. This manifoldness is due to the structural changes in the chromatin but not to the changes in the genes and they must be separated from the gene mutations that occur following hybridisation. Both are of a great importance for the origin of the species as well as for phylogeny in general.

The multiple associations of the chromosomes in F_2—F_4 in the fully fertile triple

trigenomal hybrid *N. tabacum* × (*sylvestris* × *Rusbyi*) = *N. triplex* observed before (1933) can also be interpreted by postulating structural exchanges in the chromosomes, a process which contributes a great deal to the increase of the genotypical variability of the composite plant *N. triplex.*

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Periodic Continence *Vs.* Contraceptives.

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I. The Knaus-Ogino Discovery.

With regard to the fertility of women, people have always thought that it is greatest within the period which immediately precedes and follows menstruation. For the last fifty years Dr. Capellmann's theory was often followed. In order to avoid undesirable pregnancy, he counselled abstention the first fourteen, and the last five days, of the menstrual cycle. A reaction set in among standing gynecologists towards the beginning of the century; and, after the researches of Siegel, Jäger and others, it was generally admitted that, though there exist cycle periods of maximum and minimum fecundity, properly speaking, there is no agenesic period.

In 1929 Dr. Knaus showed that, for a normal menstrual cycle of twenty-eight days, ovulation occurs between the fourteenth and the sixteenth day *from the beginning* of the menstrual flow. Dr. Knaus's researches, which were confirmed by Wittenbeck and Hermstein, did not apply to irregular cycles.

It was the Japanese Dr. Ogino, who, in 1930, solved the problem completely. He showed that, whatever the length of the menstrual cycle, the date of ovulation is separated *from the next* menstruation by a *definite* period. In other words, *the peak of ovulation always takes place between the sixteenth and the twelfth day before the next menstruation.* It is during these five days that fecundity occurs.

But may not ovulation be provoked by coition? Though the positive solution was accepted till recently by many gynecologists it is now almost universally rejected. Thus the human species follows the behaviour normal among mammals. The statistics, which have been held to demonstrate the contrary, were shown to be unreliable by Ogino.

Another objection was based on the supposed lengthy vitality of the ovum and of human spermatozoa. The researches conducted by Hoene and Behne with regard to the spermatozoa, and by Meyer Allen and Pratt with regard to the ovum, answered the objection, and led to *Ogino's rule. The eleven days immediately preceding menstruation are always sterile.* The law of inertia explains the slowness of medical opinion in accepting these conclusions.

II. Practical Applications.

In Ogino's rule we have a method for obtaining *rational fecundity*, which consists in regulating the birth of children without injury to the mother, without risking the health of the offspring, without imperilling the harmony of the family, and without running counter the enlightened dictates of sound eugenics.

Yet it has been contended that the rule is unsafe for nearly fifty per cent. of women. This exaggerated view springs from a confusion of normal with pathological cases. Gynecologists tended to regard as normal a twenty-eight-days cycle. Now this estimation is too narrow. Twenty-eight-days cycles, admitting oscillations of a maximum amplitude of five days, may be regarded as normal, and to them Ogino's rule may be applied.

The maximum fecundity occurs within five days. Three more days have to be allowed for the possible vitality of the spermatozoa. Hence, to avoid pregnancy, abstention, for a twenty-eight-days cycle,

must extend to eight days. On the other hand, a cycle 26-27 demands nine days of abstention. A cycle 26-28, or 28-30 demands ten days, and so on. Formulæ and tables have been published to facilitate the determination of the fertile days, in which intercourse is to be shunned, if conception is to be avoided.

The cycles for which the periodicity of oscillations cannot be assigned must be regarded as pathological. To them Ogino's rule cannot be applied. Hajek found oscillations exceeding 11 days in 192 women out of 1,215. Smulders and De Guchteneere declare that only rarely the irregularity is so great that the method is unsafe. They note, however, that very bad cases can often be improved by proper treatment. The security afforded by periodical continence depends on the exact application of the agenesic formula. It is plain that a competent gynecologist should be consulted, and he will require several months of observation before fixing the final formula. Allowance must always be made for critical epochs, such as marriage, childbirth, miscarriage, which pregnantly modify the menstrual rhythm. In fact, abstinence should be counselled till a regular rhythm is re-established. It should not be forgotten that in "asthenic" women keen emotions, troubles, a change of climate, may temporarily suspend or delay ovulation. Dr. De Guchteneere then recommends only the premenstrual agenesic period, reduced from eleven to nine or even eight days.

Remembering that, though all vital functions follow a definite rhythm, yet man is more than a mechanism, and consequently rigid formulæ are to be mistrusted; remembering also that many mishaps are to be traced to individual carelessness rather than to the deficiencies of Ogino's rule, we may say that periodical continence based on the same rule, affords—not indeed the absolute security of total abstinence—but the relative security of any artificial method.

Future advance in physiology will surely succeed in determining the exact date of the peak of ovulation, and the consequent length of the agenesic periods. Meanwhile, the prudent application of the Knaus-Ogino method will afford relief in the majority of cases, whereas absolute continency is not advisable, and the mother's health, the economic status of the family or other reasonable motives to militate against a new pregnancy. We believe that the conditions of society in industrial centres, among government officials, teachers, clerks, make both unchecked fecundity and absolute continence equally difficult. As long as present conditions last, periodical abstinence offers a fair solution of a most acute problem, which only too often has opened the door to solitary vice, the use of contraceptives or even downright adultery.

III. Moral Considerations.

It has been contended that the sexual function is on the same level as digestion and consequently is outside the sphere of morality. No doubt, the elaboration of the semen in man, and the menstrual cycle in women, are purely physiological processes, which do not fall under the sway of free will. But, as eating and drinking, at a certain period of development, evolve from purely instinctive operations to actions that are distinctly human; and man, though incapable of suppressing hunger and thirst, can, and has to, regulate their satisfaction, so the sexual function, though based on a physiological mechanism, transcends the same, and in man, rises to the moral order, and in certain of its activities falls under the usual law.

Now we may distinguish the positive moral law and the natural moral law. The natural usual law, regarded in God, is eternal; and it is God's supreme wisdom and will, which commands the keeping of the natural order, and forbids its violation. The natural moral law, regarded in man, is a sharing of the eternal law, through the light of reason, by which we discover what we should, and what we should not do. It is called "natural" because it is based on man's reason, and not on revelation. It is this natural moral law that bids us to speak the truth, to love and obey our parents, not to do harm to our neighbour. We call it natural, because it is not based on a mere precept, but on man's rational nature. To act deliberately against it is to sin against reason, *i.e.*, against the nature of man. It is therefore an offence against the dignity of man, and against God, who is our Creator, and the Maker of our nature.

Endeavouring now to apply these principles to the sexual function, we notice first of all that its obvious scope is the preservation of the race. We may gauge its nobility from the fact that, by its proper exercise, man shares in a way the creative power of God. The pleasure, which is inherent in it, is of the same kind as the pleasure of

eating and drinking. It is perfectly natural, and, when it accompanies the proper exercise of the function, is good, even as the function is good. But just as a gourmand offends against the natural order by severing the pleasure of eating from the nourishment and sustenance of the body, and lives to eat, but does not eat to live, so an unchaste man severs the sexual pleasure from the natural effect of the sexual act. He thereby upsets the order of nature, seeking pleasure as an end, though in connexion with sexual activity, it is a means.

Thus appears the philosophic reason why solitary vice, homosexuality and prostitution are offences against the natural law.

Now, the use of contraceptives (chemical or mechanical) tends of itself to upset the sexual cycle, whose natural end is pregnancy. It deliberately sunders the pleasure of a natural act from the natural consequence of the same. It is therefore unreasonable; it is unnatural. I for one cannot see how in birth control through the use of contraceptives, the act differs morally from solitary vice or even homosexuality. In fact, I believe, it is usually more serious than mere solitary vice, for the continuous and fruitless stimulation of the female genital organs leads to serious disorders, both psychic and physiological.

IV. AN OBJECTION.

I have not great hopes that people endowed with the Neo-Malthusian mentality will readily see the strength of the philosophic argument I have just outlined. Others who admit man's dependence from a Supreme Cause and Ruler, not only in regard to the physical order, but also with respect to the moral order, will perceive the sinfulness of artificially tampering with the generative process. But they will ask themselves how the practical application of the Knaus-Ogino rule is consistent with the demands of morality.

It is to be noted at the outset that a person's intentions are not in question. A married couple may have intercourse in the normal manner, with a lustful mind. The action, which is good in its materiality, is vitiated by intention. But can a good intention "spiritualise" an intrinsically crooked action? We do not think so, for we believe that "the end does not justify the means".

Now to the matter in hand: the natural moral law demands that the sexual act should be performed normally and completely. It demands also that the health of the mother should be safeguarded, that children should not be brought into the world in utter disregard of the dictates of prudence. Circumstances may arise when a new birth may prove disastrous. Then abstinence is the obvious course. But prolonged abstinence may upset conjugal harmony, may, in individual cases, be unadvisable.

The Neo-Malthusians advise the use of contraceptives. We do not agree with them, for the reasons already given, and for other reasons, which we cannot develop here.

Then we counsel periodical continence, in the sense of the Knaus-Ogino rule.

Here the physiological processes are not interfered with. The natural effect of the act is not frustrated by artificial contrivances. Woman is not unjustly deprived of the benefits both physical and psychic, of certain substances, which are absorbed by the female organs, and act as metabolic stimulants. A new pregnancy is avoided simply by taking advantage of the normal cycles of sterility and fecundity. In other words, the Creator's law is made use of, which consists, in the spontaneous alteration of fertile and sterile days. This law is not of man's invention. It is natural. It is not twisted to immoral purposes, but is applied for good reasons. If women were unfit for sexual intercourse during the agenesic days, if they felt normal repugnance to it, we might pause and ask ourselves whether such an attitude were not indicative of moral perversion in the performance of the conjugal act during the sterile period. But no such unfitness, no normal repugnance is discoverable.

Hence we believe that no moral blemish can be attached to those who regulate their conjugal life according to the Knaus-Ogino rule.

It is finally to be noted that while continence is the basis of the Knaus-Ogino system, contraception implies the total denial of continence.

We believe that total continence may be exercised by a few (both in marriage and outside marriage), whose normal training is of a very high order, and whose spiritual ideals are divinised by constant communion with God. For the majority, the normal exercise of the sexual function in marriage is not fraught with any danger or with any serious consequences. They should be generous, and should not shirk the burdens, and blessings of numerous families. To those

unfortunates—and they are luckily few—for whom eugenic reasons, or economic reasons of a serious character, dissuade normal generation, we counsel periodic continence—and we believe the counsel is good and praiseworthy.

Fruit Research in India: Its Importance, History and Scope.

By Dr. G. S. Cheema, D.Sc., I.A.S.,
Horticulturist to Government, Bombay, Poona.

Introductory.

JUST as the Department of Agriculture forms a minor subject in the administrative classification of the Government of India, the development of fruit industry forms indeed a very small part of the activities of the Agricultural Departments in India, in spite of the fact that India claims to have more than five million acres under fruit and vegetables. Consequently this country, which has great potentialities for development, imports annually fruit worth about twenty million rupees from foreign countries. Not only is this so, but while the acreage under fruit and vegetables has remained practically stationary for several years past, the imports of foreign fruit have increased by leaps and bounds in recent years. The steady acreage under fruit and vegetable and the increasing imports indicate that the total consumption in the country of these commodities has increased but it has not been followed by any extension of fruit and vegetable cultivation.

The importance of the development of the fruit industry is, however, recently attracting the attention of the Agricultural mind in various parts of India, which is indeed a welcome sign of awakening in the right direction. The Imperial Department of Agriculture is now financing some fruit schemes in the different provinces with a view to develop this industry. It is generally recognised that in the economic uplift of rural areas, in the financial success of large irrigation projects which are undertaken at the cost of huge amounts in the Deccan, Sind and other parts of the country, and in the successful development of vast tracts of countryside, where the ordinary agricultural crops are not a financial success, the fruit industry will play a very important rôle. It is then natural that the question of fruit research should play as much part in the agricultural development of the country as any other branch of agricultural science, this being an important and valuable source of income to the peasant. The present time is, therefore, most opportune to stress upon the minds of the general public the great importance of fruit research in India, and this note will have fully served its purpose if it does so.

History of Fruit Research.

The fruit research dates back to the middle of the nineteenth century. Ferminger (1863), Woodrow (1877) and Bonavia (1890) have made valuable contributions to the limited volume of literature on the subject in India, by their attempts to describe the existing varieties of fruit and to classify them as far as possible.

The records of the work done under the auspices of the Pusa Institute of Agriculture show but very little headway made in this direction. This work chiefly deals with the establishment of a Fruit Farm at Quetta, and some work on the drying and packing of vegetables.

The United Provinces Department of Agriculture have restricted its activities to the establishment of farms and variety trials of exotic fruits. The Saharanpur Botanical Gardens have contributed substantially towards this work from the early years of the nineteenth century.

The Tarnab fruit farm has shown active interest in the development of the fruit industry in the North-Western Frontier Provinces. The introduction of improved varieties of plums in this Province is perhaps one of the few important projects which this Farm has carried out successfully. Some observations on the improvement of fruit stock have also been recorded in the reports of this Farm.

The Punjab and Central Provinces Departments of Agriculture have also done some work in this line. In the Punjab, a regular Department of Horticulture has been recently organised, and fruit work is making progress.

The Bombay Department of Agriculture organised their horticultural work as late as 1908, when the investigations on fruit trees were allied with botanical research. The

records show that a fair attempt was made to study the needs of the industry in the various parts of the Presidency, and to indicate possible lines of research to be adopted to solve the problems of the fruit grower.

It was in 1921, that the Bombay Department of Agriculture took the lead and organised a special horticultural branch with a view to solve the various problems of fruit growing in the Presidency. A great effort is made to bring the work of the Bombay Department of Horticulture in line with the recommendations of the Royal Commission on Agriculture in India. Their activities to evolve improved strains of fruit by selection, the study of the soils and their relations to the growth of fruit trees, and the marketing investigations are now well in hand. This department has also attempted successfully for the first time in the history of Indian fruits the problem of Export of Indian Fruit to the European markets.

The Madras Presidency, Bihar and Orissa and Bengal are yet studying the means to establish their fruit farms and to stimulate researches in this direction in the near future.

It is observed from the survey of work done that the earlier attempts at horticultural research were spasmodic and lacked continuity—a factor which is essential to build up a really scientific structure. It may be true that these attempts have but poorly subscribed to the industrial benefit of the country, but the importance of the work cannot be belittled, as a beginning had to be made perhaps in this very manner.

It may be clearly stated here that although the fruit industry and researches towards its development, now form the major part of the activities of most of the agriculturally advanced countries of the world like Italy, France, and various states of the United States of America, almost every country started her work under equally undeveloped conditions. It is only with steady and thorough research and organisation that they have built up their modern industry. Italy could not have held the monopoly of fruit products if she had not staked millions of liras in finding ways and means to improve the quality of their fruit crops and developed a system of handling and marketing them efficiently. The United States of America could not have developed their fruit industry to the present high level, if they had not spent millions of dollars in fruit researches, nor could the French have boasted of their high efficiency if their Government were holding back the expenditure of their gold. The same principles hold good to the conditions of the present-day India. It is feared that no developments in this direction are possible, without properly organising and following up researches on fruit.

It is surprising to note that in India the majority of the Provinces have not as yet established even a fruit farm where such researches can be carried out. But it is recently announced that the Imperial Council of Agricultural Research has taken the initiative in this direction and has agreed to finance some of the Provinces in establishing their fruit farms.

The importance of fruit researches till recently was not fully recognised by any Department of Agriculture in India, and probably it is this fact which largely accounts for the neglect of these researches.

SCOPE FOR WORK.

Even at present as explained above, almost every branch of the Indian fruit industry remains still to be explored fully and the Science presents a wide field for active research. The chief lines of work for the development may be classified under the following heads:—

1. Improvement in the quality of seeds and nursery stock and their standardisation.
2. Improvements in the methods of cultivation and the control of diseases.
3. Efficiency in transport and safety in delivery of fresh fruit.
4. Improvement in the system of marketing and storing fruit.
5. Proper utilisation of the surplus produce.

The Royal Commission on Agriculture in India have devoted a chapter in their report to horticulture and plantations, and have indicated the possible lines of research to be conducted for the development of the fruit industry. The Commission report: "There is, however, much important research work to be done, notably in selecting and classifying root stocks. The aggregate number of fruit trees in the country is very large and an improvement in quality alone, quite apart from the increase in number, would confer great benefits on the people." The Commission further proceed to state that investigations into transport and markets

must form an essential part of any policy of active encouragement of either fruit or vegetable production. They also suggest that the possibilities of the home market for preserved and dried fruit and vegetables should be explored.

In fact researches in all these directions must be conducted simultaneously, or else the immediate benefit of any investigation in any particular line cannot be felt. For example, it is now found possible to export mangoes to European countries, but it is not possible to make this a commercially practicable project until and unless suitable and more economical transport facilities are secured for this trade. Comprehensive researches in all allied lines are, therefore, essential to succeed in the development of an industry.

(1) Now turning to the lines of research indicated above individually, it is felt that a great deal of investigation is required in selecting and standardising our fruit and vegetable before a desirable quality for the market is obtained. It is really not known if any definite effort is already being made in this line in India, as yet. References, however, are available giving expression to the necessity of these investigations and reporting about certain abortive attempts made here and there. The disjointed nature of these accounts seems to be due to lack of funds and policy and perhaps necessary amount of patience so essential in following up research. Investigations to improve the quality of seeds and nursery stock are imperative as they form the basis of the whole structure on which the industry can be built.

(2) Improvements in the methods of cultivation of our fruit trees, and the control of diseases and pests form another important aspect of this industry. A very fruitful research work can be undertaken to find out the suitability and adaptation of various varieties of fruit to soil and climatic conditions of different tracts. The physiological effects of various soils on the growth of commercial strains also require a careful and detailed investigation. The present tendency is to refer to foreign literature and to advise prospective growers to follow foreign treatments. Such advice is often found to be far from satisfactory, and in many cases it is found disappointing and ruinous. There are instances where hurried observations seem to establish facts which do not stand later tests. There are also instances where application of foreign treatments has completely destroyed plantations. There are also cases where money spent on treatment is not economical and the benefits which accrued discourage to follow such remedies. Most unfortunately, however, a disregard of these points even on the part of high authorities has already proved a ruinous policy. Research in this line is expected to be as profitable as in any other line and presents a very great scope for work.

(3) The conditions with regard to cost and efficiency of transport and the safety of goods during transit are at present extremely unsatisfactory in India. This line of development embraces a wide field. The proper packing materials to suit the requirement of the present means of transport is yet to be designed. Researches are needed in the ways and means of stocking and hauling packages and economically transporting them from the place of cultivation to the distributing centre. Researches in this direction appear to be of an inter-provincial nature and one can easily find reason why they are neglected. There is no inter-provincial activity at present so far as this aspect of fruit trade is concerned. All provinces are carrying on their work in a very air-tight compartment manner. But no one can deny that this line of research forms a very integral part of the development of the industry as a whole. It is no use having a good quality of fruit if it cannot be exported or transported to places of demand. It is no use opening up large plantations and spending money if the produce cannot be economically distributed.

(4) The part which the system of marketing plays cannot be sufficiently emphasised. A small amount of research work in this direction has been done in India, but the findings could not be put into effect as several other allied agencies and factors such as transport, packing materials and freights, are not suitably harmonised. The Bombay Presidency, undoubtedly has taken the lead in this direction. The Government of Bombay have appointed a committee to investigate this subject. It is anticipated that the line of development which this Committee will suggest will be worth following. These researches will be useful for inter-provincial work. But there is a need for undertaking such researches in other Provinces to solve their local difficulties.

(5) The utilisation of surplus produce of the season is another line where researches lack in India. Recently a couple of schemes such as the Manufacture of Lime Juice in the Bombay Deccan and the Establishing of a Canning Laboratory in the North-West Frontier Provinces have appeared before the public. Beside these schemes, there does not seem to be anything else of much interest. The failure of Koonoor Laboratory of course has caused some setback in this direction. Of course, the best way to get over such a difficulty is to have well-considered projects before money is invested and effort is made to carry on the work. The failure of one scheme should not necessarily discourage the carrying out of another. There is no denying of the fact that failures in researches will be as common as successes if not more.

The above outline will show that practically every aspect of fruit industry remains to be studied. Considerable preliminary experimental work must be conducted probably at considerable expenditure to organise researches in this direction. It will not be out of place to mention at this stage the chief ways by which fruit researches can be successfully carried out. It is suggested that the fruit researches must be classified as the *Central Subjects* and the *Provincial Subjects*.

The following research work may be included in the list of *Central Subjects*:—

(*a*) Researches relating to the import and export of fresh fruits and fruit products.

(*b*) The problems connected with the marketing of fruit including transport.

(*c*) The investigations relating to the preservation of fruit and the manufacture of their products.

Other researches are more of a provincial nature and may be left to the Provincial Departments to follow. These can be grouped as follows:—

1. Investigation connected with the formation, structural fertility and management of soils suitable for fruit culture.
2. The study of various climatic conditions, their suitability to the growth of various crops and the selection of suitable commercial varieties.
3. The work of propagation.
4. Problems connected with the lay-out and general cultural operations.
5. The extension of area under different crops.

Such a division of work in dealing with fruit researches is indispensable. As may be seen from the items put under the central subjects they involve an all-India and inter-provincial activity. The Central Government is the only competent authority that can handle questions and problems of such wide dimensions. The present administrative restrictions do not allow the Provincial Governments to pay any attention to these subjects. Even if they tried, they would find it not only an expensive affair owing to lack of facilities but also an irksome matter causing delay at every step. Then the Provincial Governments have not the necessary freedom of action in these matters. Necessary rules and regulations of Government in developing an All-India Industry can be framed and issued by the Central Government alone to make them effective.

The fruit industry and research in it are in fact in their infancy. Its importance is always overshadowed by other agricultural developments, thus throwing in the background these researches. It is anticipated that with the present awakening in Agricultural Department these researches will be given equal place as those relating to other agricultural industries. The effort which is required to be made to develop this industry and put it on a sound footing is not in any way less expensive and less cumbersome than other developments and these activities should not be considered of less importance as it is commonly understood.

Letters to the Editor.

The Colouring Matter of the Seed-Coat of *Abrus precatorius*, Linn. (Scarlet Variety).

THE first attempt towards the isolation of the colouring matter of *Abrus* seeds was made by Sarkar (*Biochem. J.*, **8**, 281-86, 1914) who extracted two colouring matters, yellow and scarlet, by soaking the crushed seed-coat in water and finally separating them with ether. He purified the scarlet colouring matter by preparing the insoluble copper salt and from a study of some colour reactions concluded it to be a tannin substance. The next reference that "anthocyanin is sometimes developed in the cells of the testa of seeds of *Abrus*" is recorded in Onslow's book (*The Anthocyanin Pigments of Plants*, 1925, p. 30).

The present author has, however, been able to isolate an anthocyanin and gallic acid from the seed-coat. The presence of gallic acid probably confused Sarkar to come to the premature conclusion that the colouring matter of *Abrus precatorius* was a tannin substance. The anthocyanin has been named *abranin*.

Hot aqueous extract of the crushed seed-coat is precipitated with excess of lead acetate. The lead salt is macerated with glacial acetic acid in the cold and the filtrate which is of a pink red colour is precipitated with ether till the pink colour of the solution just disappears. The colouring matter is obtained by decomposing the precipitated blue lead salt in ethyl alcohol (98%) suspension with hydrochloric acid and finally precipitating the filtrate with ether. The crude abranin chloride thus obtained on purification in the usual way and on remaining over calcium chloride in a vacuum desiccator melts at 178–79° with previous sintering. Gallic acid is obtained by decomposing the lead salt that is recovered on concentrating the acetic acid filtrate.

Abranin chloride isomerises readily in neutral solvents like water, methyl and ethyl alcohols, etc. Its colour reactions have been studied. The sugar of hydrolysis of abranin chloride has been identified to be glucose. Abranin picrate, prepared in the usual way, has been obtained in the form of chocolate-red plates and melts at 149–50°. Determination of the distribution number of the substance confirms it to be a monoglucoside. The absorption spectra of the colouring matter in methyl alcohol-hydrochloric acid have been studied.

NARENDRANATH GHATAK.

Chemical Laboratory,
Allahabad University,
December 10, 1933.

Bacteria in relation to Soil Fertility and Crop Yield.

"A PROBABLE correlation between soil fertility, crop yield and the number of Microflora has been suggested by various workers. The writer while working at Rothamsted on Hoos-field (Permanent Barley) plots was able to show that a correlation existed between soil fertility, crop growth and the number of Bacteria in the soil. Since his return to India he has been engaged in making Microbiological investigations in connection with the reclamation of Alkali soils. The reclamation work is being carried on barren lands in the Punjab and these cover a good deal of area in the Province. Soils were brought from the experimental fields with a soil borer from surface soil 0″–6″. About half a dozen plantings were done. The medium used was Thornton's Mannite Agar. The following dilutions were made:—

1. 25 grams of soil in 250 c.c. of water 1/25.
2. 1 c.c. of (1) in 100 c.c. of water 1/250.
3. 1 c.c. of (2) in 100 c.c. of water 1/250000.

Total number of colonies were counted after a week's incubation and the average taken from the five plates examined for each plot. The yield of rice crop is taken as an indication of the state of reclamation and the stages of reclamation which are recognised at the Chakkianwali Reclamation Farm (Punjab) are as follows:—

(*a*) If the yield of rice crop is 12 maunds or below, the land is only partially reclaimed.

(*b*) If the yield of rice crop is between 12 to 20 maunds per acre this indicates an advance of reclamation over (*a*).

(*c*) If the rice crop is 20 maunds per acre or over then the land is considered to be fully reclaimed.

With a view of obtaining comparison which would indicate the stage of reclamation reached the writer has been engaged in carrying on work on the quantitative aspects of Bacterial numbers in the different types

of soils produced during the process of reclamation.

These replicated studies have shown that quantitatively the number of Bacteria is different in various plots reclaimed and it is of great interest to note that there seems to be a definite correlation between soil fertility as indicated by the crop growth and the number of Bacteria. Thus different plots of reclaimed soils, namely, those which give a yield of (i) over 20 maunds, (ii) between 12 to 20 maunds, (iii) below 12 maunds show Bacterial numbers of the magnitude of 19,750,000; 14,250,000; 8,250,000; and 5,250,000 per gram of dry soil respectively.

A similar correlation has recently been established by Dr. A. N. Puri [*Punjab Irrigation Research Laboratory Memoirs* (*in press*)] between the degree of alkalisation or saline contents and the crop yield, the greater the saline contents, the lesser the yield and *vice versa*.

These observations seem to indicate that during the process of reclamation of Alkali soils different plots giving different Rice yields have Bacterial population also different, the number of Bacteria having a correlation with the crop yield."

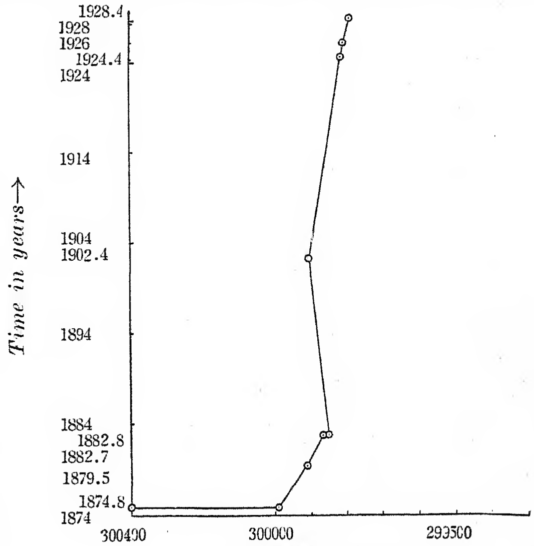
JAGJIWAN SINGH AHLUWALIA.

Botanical Laboratories,
Government College,
Lahore,
December 15, 1933.

The Velocity of Light.

DR. ALARABY in a brief note on the decrement of the velocity of light[1] mentioning De Bray's article[2] gives us to understand that the details would be published in the *Ind. J. Phys.* and the *Phys. Rev.* Hence it would be premature on our part to question his conclusions, yet we have no hesitation to contend that so far we are not in possession of even a *single* definite experimental evidence to point out the decrement in the actual velocity of light. So any mathematical account calculated on the basis of the results up till now obtained certainly would prove erroneous. All the experimental results of the velocity of light so far quoted and derived only go to show that each experiment has led to obtain higher accuracy in the result and we are yet to determine the value of the 'constant'. Michelson himself after declaring his result[3] obtained in 1924 mentioned that in the succeeding year he would be able to 'furnish results four or five times more accurate'.

In *Nature* of Oct. 22, 1927, p. 602, De Bray has provided a table of experimental values of the velocty of light, indicating seven trustworthy determinations. Plotting the results we obtain the following graph which



is something of a sort of a sine curve and not merely a straight line inclined to the axis of time as mentioned in *Nature* of April 4, 1931, p. 522. De Bray secures a straight line in the graph as he only considers the results obtained after the year 1902. We maintain that if the curve fails to tend asymptotically it is because we have not as yet reached the value of the 'constant'.

Admitting for a moment the determinations as indicating the decrement how is it that the velocity of light *invariably* decreases in an 'excellent linear law of variation' in spite of the earth's magnetic field of varying intensity.

Even the General Theory of Relativity is not definite on this issue.

M. KARIM.
C. M. BHASKER RAO.

Aligarh,
February 6, 1934.

[1] *Curr. Sci.*, 2, 244, 1934.
[2] *Nature*, April 4, 1931.
[3] *Nature*, Dec. 6, 1924, p. 831.

I HAVE read with interest the remark made by Messrs. Karim and Rao about my note concerning the velocity of light (*Curr. Sci.*, **2**, 244, 1934).

Of course due to many reasons no definite experiment has been carried out to study the variation in the velocity of light. Assuming such a variation without any reason and formulating a mathematical structure on this basis would be undoubtedly completely wrong. At this place we can ask the question: can we try to understand the results obtained by different observers from time to time in light of the Theory of Relativity (Vrkljan, *Zeit. f. Physik*, **63**, p. 688, 1930 and others) that seems to predict a variation in the velocity of light?

It is evident that the results obtained by different observers as quoted by De Bray are not accurate. A graph has been drawn by Messrs. Karim and Rao that they state to be like a sine curve—which is not a sine curve—the existence of such a curve will mean a periodic variation in the velocity of light. About the other letter of De Bray (*Nature*, April 4, 1931) they mention about the straight line and explain that "if the curve fails to tend asymptotically it is because we have not yet reached the value of the constant." I do not see how the asymptote comes in a way and what it has to do with it. Next they have pointed out about the magnetic field variation of earth mentioned by De Bray. As no definite relation expressable in equations has yet been found out, as to what will be the nature of variation it is difficult to say with certainty as to how the light should vary.

Here are we not justified to study the problem from the point of view of an expanding universe in which we may predict such an occurrence?

It seems so revolting at this stage to make a statement about the velocity of light, which would no doubt take at least hundreds of years of carefully observed data with more elaborate electrically measuring devices for finding out the velocity of light.

It would be interesting to note that it has been pointed out in *Nature* (Feb. 3, 1934, p. 169) that periodic variation in the velocity of light as observed at Mt. Wilson (*Nature*, **130**, 15, July 2; 277, Aug. 20, 1932) has been construed by the authorities of Mt. Wilson in Science Service to be due to some seasonal instrumental error. The best value of the velocity 299,774 Km./sec. is likely not going to change by more than one or two......in the last figure. Pease and Pearson are carrying out further investigation with better methods, and we shall have to wait for years till definite results are obtained to prove that our theoretical calculations and *expectations* are wrong.

M. ALARABY.

Lyceum,
Arrah, B. and O.,
March 12, 1934.

On the Occurrence of Sori on the Upper Surface of the Leaf of *Nephrolepis davallioides* var. *furcans*.

OCCURRENCE of sori on the upper surface of the leaf of leptosporangiate ferns is rather uncommon. As far as I know this is reported in: *Aspidium (P) anomalum (Polystichum aculeatum)* (Hooker[1]), *Deparia moorei* (Thompson[2]), *Polypodium lepidotum*, *P. proliferum*, *Asplenium trichomanes*, *Scolopendium vulgare* (Moore[3]) and in the doubtful case of *Acrostichum (Rhepidopheris) peltatum* (Goebel[4]). In the present case the sori are superficial, borne on the upper surface and are always terminal on the open veins which do not reach the leaf margin (Figs. 1, 2, 3). They are all imperfectly developed, the indusium is scaly, peltate and white in colour and, as a result, the sori appear as white intramarginal patches along the margin of the pinnules. The sporophylls are normal leaves all the pinnules bearing the otherwise normal sori in regular order; and the phenomenon cannot be regarded in this case as anomalous, abnormal or accidental. I have examined over a hundred pot plants, and only 4 or 5 of them bore normal sori on the under-surface of the pinnules, and that too, only in 2 or 3 leaves in each plant. It seems that the plant is giving up propagation through asexual pores. The plants, in two pots, that have shown this phenomenon are still growing in my garden.

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[1] Hooker, *Species Filicum*, **4**, p. 27; also *Ferns*, **1**, p. 217.

[2] Thompson—*Trans. Roy. Soc.*, Edin. **50**, pp. 837-856.

[3] Moore, "Note on some Suprasoriferous Ferns", *Journ. Linn. Soc.*, **2**, pp. 129-30.

[4] Goebel, *Organography*, Part II (Eng. Ed.), pp. 486, 493-94.

Prof. Bower[5], who holds the abaxially superficial position of the sorus as derived from the primitive distal or marginal position as a result of 'phyletic slide' (pp. 219-22; also *Ann. Bot.*, **28,** p. 326), regards the above cases as anomalous (*cf.* Goebel, p. 494). Thompson, however, does not agree with Bower. He considers that these

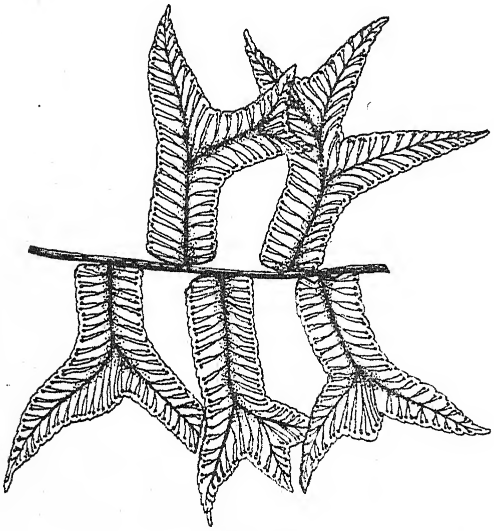

Fig. 1.
Part of the Sporophyll showing Sori on the upper surface. Size normal.

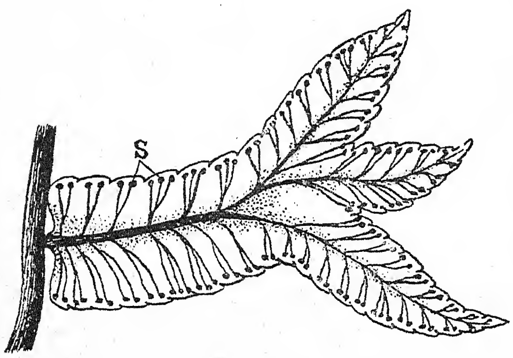

Fig. 2.
A Pinnule. ×2. S—Sori.

occurrences of adaxially superficial sori are in consequence of certain yet undetermined conditions (p. 855). But both of them seem to agree with Goebel that "the sporangia in general strive for a position on the under

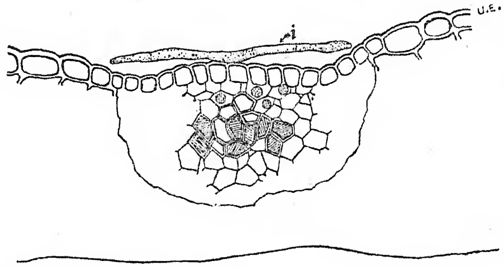

Fig. 3.
A Sorus in cross-section: Camra lucida drawing. Semi-diagrammatic. × 300. *i*—scaly indusium. UE.—upper epidermis.

side of the leaf the more the portion of the sporophyll bearing the sporangia is constructed like a foliage leaf" (p. 494).

From a study of the primitive groups of pteridophytes, living and fossil, where the adaxially superficial position of the sporangium appears to be the rule, the present writer is inclined to suggest that the almost normal occurrence of such cases in so many diverse groups of leptosporangiate ferns might refer to a stage abandoned in the phyletic march in the position of these organs from axis—axil—upper-surface—intramargin—margin—under-surface of the leaf for "the imperfectly developed parts have played important rôle in arguments on Evolution" (Bower, p. 162).

GIRIJA PRASANNA MAJUMDAR.

Department of Botany,
Presidency College,
Calcutta.
February 19, 1934.

Isomerism in Chloralides.

RECENTLY Chattaway and Bell (*J.* 1934, page 43) have studied the isomerism of the condensation products of chloral with some phenols.

We have also been working on the isomerism of chloralides derived from α-hydroxy acids, the preliminary note on which was read at the meeting of Chemistry Section of Indian Science Congress, Bombay, 1934.

In view of Chattaway and Bell's paper, we think it necessary to publish some of our results.

From the condensation products of different α-hydroxy carboxylic acids with chloral

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[5] Bower, *The Ferns*, **1**, Chap. XII; *cf.* also *Origin of a Land Flora*, Chap XL.

hydrate (in presence of H_2SO_4), two chloralides have been obtained after careful recrystallisations. Thus, *d*-tartaric, racemic and lactic acids have each given two chloralides.

Chloralides of	Melting Points
d-tartaric acid	..(i) 162° and (ii) 175°
Racemic acid	..(i) 160° and (ii) 215°
Lactic acid (Merck's)	..(i) 62° and (ii) B. P. 212°

Lactic acid chloralides are being carefully studied.

This line of investigation will greatly help to remove the discrepancies that are found with regard to the melting points of the chloralides already recorded in literature: some of them may be due to cis-trans-isomers.

N. M. SHAH.
R. L. ALIMCHANDANI.

Karnatak College,
Dharwar,
March 3, 1934.

The Structure of Singly Ionised Selenium.

IN continuation of the work of the writers on Se III* the analysis of the spectrum of singly ionised selenium has been completed. The source employed was the ordinary discharge tube, wherein pure powdered selenium was heated. The very extreme ultraviolet region, the vacuum spark between aluminium poles tipped with metallic selenium served as a convenient source in addition to the discharge through capillary tubes.

This spectrum was observed to be similar in many respects to the spectrum of As I.† The intervals 5s $^4P_1$—$^4P_2$, and 5s $^4P_2$—$^4P_3$ are found to be 1483·5 and 1920·9 respectively. Adopting a value of 5s $^4P_3$= 76320 calculated from appropriate series members the absolute values of the various energy states characteristic of Se II could be obtained. Some of these are:

$$5s\ ^2P_2=73638$$
$$5p\ ^4D_3=58932$$
$$5p\ ^4P_3=56602$$
$$5p\ ^4S_2=55692$$

The intervals of 5p $^4D_4$ terms are 412·7, 1356·4 and 1730·6 while the 5p ^4P term intervals are 3728·1 and 1621·2. A full report of the results obtained will be published shortly in the *Proceedings of the Royal Society of London.*

S. GOPALAKRISHNA MURTY.
K. R. RAO.

Science College,
Andhra University,
March 8, 1934.

* *Curr. Sci.*, **1**, June 1932.

† A. S. Rao, *Proc. Phys. Soc.*, **44**, 594, 1932.

Spectrum of Ce III.

MR. DABHOLKAR, in a note published in the February issue of *Current Science*, has made some observations on my work on the regularities in the spectrum of doubly ionised cerium. The error pointed out by him regarding the classification of the line λ 2238·69 is only a case of misprint. If he would be kind enough to look into my paper again, he would notice that the combination A—*k* is to be replaced by $5d^2\ ^3F_2$—*k*. The fact that 44655·1 is given as one of the term values should have made the change clear. It may be pointed out here that the frequency differences in my analysis of Ce III lines were mostly found to be correct to within ·1 frequency units. The analysis explains practically all the strong lines and there can be no doubt about the genuineness of the terms which have been discovered. The fixing of J and K values of the terms in a spectrum like that of Ce III can, for obvious reasons, hardly be expected to indicate anything more than a personal opinion, and it is therefore needless to enter into a discussion of this aspect of the matter here.

P. N. KALIA.

Department of Physics,
Government College, Lahore,
March 15, 1934.

Oxidising Agents as Fertilisers.

IT has been shown in a previous communication[1] that improved growth of seedlings can be obtained by treating soils, manured or otherwise, with different oxidising agents. As the results were of much scientific interest and, at the same time, indicated possibilities of extended practical application, further work was carried out growing different plants in pots as well as plots, and studying the influence of various treatments on general growth and yield of crop.

[1] *Nature*, **132**, 1001, 1933.

It was observed that vigorous oxidising agents like potassium permanganate or hydrogen peroxide were effective when applied either before the organic manure or at the same time with it: they tended to depress the yield if applied as top dressings 2–3 weeks after sowing. On the other hand, milder agents like the oxides of iron or manganese produced the most favourable effects when applied, as top dressings, at least a fortnight after sowing or transplanting as the case may be. In all the cases, the improvements were noted to be all-round, shoot height, leaf area, tillering and grain formation being favoured by the treatment. The following are some of the results obtained :—

TABLE I.

POT EXPERIMENTS.

Treatment	Yield in Grams			
	Ragi (*Eleucine coracana*)		French beans (*Phraseolus vulgaris*)	
	Grain	Straw	Pods	Stem and root
POT EXPERIMENTS.				
Soil (30 lbs.) + Seed-cake (30·0 g.) + Super (3·0 g.) + Potassium nitrate (2·0 g.) + Potassium sulphate (1·5 g.) (*Control*) ..	296·4	115·7	67·4	22·0
Control + Fe_2O_3 (30·0 g.) applied as top dressing	343·7	124·5	102·8	26·8
Control + MnO_2 (7·5 g.)	345·2	116·4	104·0	28·2
Control + H_2O_2 (50 c.c. of 6 per cent.) ..	319·6	120·3	80·7	24·1
Control + $KMnO_4$ (3·0 g.) (applied before sowing)	398·4	146·9	72·7	23·5
IN SMALL PLOTS (484 sq. ft. in each case).				
Unmanured (*Control*)	1430·5	1550·9	..	..
Unmanured + oxidising agents $KMnO_4$ (at 100 lbs. per acre)	2066·9	1786·0	..	..
Fertilised with farmyard manure alone (3 tons per acre) (*Control*)	2181·3	2100·4	..	..
Fertilised with $KMnO_4$ (100 lbs. per acre) (applied together with the farmyard manure)	2870·0	2797·0	..	..
Fertilised with $KMnO_4$ (100 lbs. per acre) applied in stages after the farmyard manure	2306·9	2313·5	..	..

The above observations have been supported by a number of other results so that it may be concluded that whether any manure is applied or not, treatment of the soil with oxidising agents leads to beneficial results.

The practical significance of some of the foregoing observations would be realised when it is stated that in many countries, tropical as well as temperate, there are vast tracts of land which are rich in iron or manganese—particularly the former—and contain high percentages of the corresponding oxides so that one has only to grind up rocks containing them and apply them to land in the desired proportion. Since it has been observed that even soils which are naturally rich in iron respond favourably to the treatments, it may be inferred that all soils would give increased yields as the result of applications of top dressings of iron or manganese oxides.

The quantities of available mineral oxides —particularly that of iron—are far in excess

of the requirements of metallurgical industries, so that there is no fear of shortage of raw material for the latter. There are also vast supplies of low grade minerals which are unsuitable for other purposes and which could, with advantage, be utilised as fertilisers. The results of the present enquiry should also prove of value to the synthetic fertiliser industry by leading to the production of a new type of fertiliser which, in addition to supplying the mineral or nitrogen requirements of the plant, also facilitate the oxidation changes in the soil.

The fertilising action of different oxidising agents raises a fundamental question as to how they react with the soil and what effect they have on soil microflora and microfauna. As already observed, there is increased oxidation of organic matter resulting in greater evolution of carbon dioxide from the soil. This oxidation cannot, however, be correlated with microbiological activity which is prominent only immediately after the application of organic manure. The beneficial effect is best observed, at any rate, in the case of metallic oxides, only under conditions when micro-organisms are not actively functioning so that the oxidation changes observed in presence of the former would appear to be largely due to purely non-biological reactions.

A further question of practical importance which arises in this connection is as to whether it is desirable to adopt any system of fertilising which would lead to the rapid depletion of organic matter from the soil, whether it is not more important to devise means to conserve Carbon and Nitrogen in the soil rather than hasten their destruction. The observations of the present authors as also those of other workers in the field have shown that most cultivated soils, particularly in the tropics, have very poor retentive power for organic matter and that they get rapidly depleted irrespective of the quantities of organic manures applied to them. Owing to the favourable climatic and other conditions, the decomposition goes on practically all round the year so that the added manure possesses very little residual value. In the light of the above, it would appear to be more profitable to hasten the decomposition of organic matter during the lifetime of the crop for which it is applied and thus obtain the benefit of the increased yield rather than lose the unused residue after harvest and during periods of fallow. The quickened decomposition would only help to hasten the normal cycle of Carbon and Nitrogen in nature so that the foregoing observations would suggest the possibilities of a new system of fertiliser practice which would take advantage of the processes occurring in nature rather than devise means to oppose them. Further work is already in progress to extend the above and related observations, but it is also hoped that other workers would verify our findings and thus help towards further elucidation of their practical significance.

V. SUBRAHMANYAN.
C. R. HARIHARA IYER.
R. RAJAGOPALAN.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
March 25, 1934.

The Valence Angle of Oxygen in Dimethyl Oxide and Ethylene Oxide.

THE modes of vibration of a symmetric, non-linear triatomic molecule of the type XY_2 have been worked out by Bjerrum, Dennison and others. The three fundamental frequencies in its vibration spectrum are shown by these authors to be functions of the valence angle of the atom X, and of the binding forces between X and Y, and between Y and Y. From a knowledge of the vibration spectrum of the molecule, we can, therefore, calculate the valence angle of X and the binding forces between the atoms.

The valence angle of oxygen in dimethyl oxide $\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>O$ calculated in this manner from its fundamental Raman frequencies 1102, 416 and 921 cm.$^{-1}$, is found to be about 102°. This is very near the tetrahedral angle of 109·5° usually supposed in theoretical discussions to represent the valence angles. On the other hand, in the heterocyclic compound ethylene oxide $\begin{matrix}CH_2\\|\\CH_2\end{matrix}\!\!>O$ if we calculate the valence angle in the same manner, it comes out much smaller. The principal Raman frequencies of this compound, as measured by me, are 865, 810 and 1151 cm.$^{-1}$, and they give for the angle a value of only 64°. The smaller value in this compound is evidently due to the presence of a chemical bond between its two carbon atoms, which is absent in dimethyl oxide; the bond will naturally bring the

two carbon atoms close together, and thus diminish the valence angle.

The large discrepancy between the angles in the two compounds is supported by independent evidence. The permanent dipole movements of dimethyl oxide and ethylene oxide are $1 \cdot 29 \times 10^{-18}$ and $1 \cdot 88 \times 10^{-18}$ e.s.u., respectively, the latter value being thus much larger. Indeed the two moments bear a ratio $\frac{1 \cdot 29}{1 \cdot 88} = 0 \cdot 69$, which is practically the same as the value $\frac{\cos 51^\circ}{\cos 32^\circ} = 0 \cdot 74$, which we should expect from their relative valence angles.

In connection with the above calculation of the valence angles from the Raman frequencies, we should add that in both the compounds the binding forces between the atoms come out of the proper magnitude.

N. GOPALA PAI.

210, Bowbazar Street,
Calcutta,
March 25, 1934.

A Note on the Disintegration of α-Particle.

IN a recent paper announced in *Current Science*, 1933, and since published in *Phil. Mag.*, **14**, p. 1097, 1933, we have derived the wave-statistical formula connecting the disintegration constant and the velocity of emission of α-particle, *viz.*,

$$\lambda = \text{Const.} \frac{\sqrt{E}}{\gamma_0{}^2\, h \cot u_0} \cdot e^{-2k(2u_0 - \sin 2u_0)} \quad ..(1)$$

where E = the energy of the α-particle, γ_0=the critical radius of emission, $k = \frac{4\pi z^* e^2}{h\sqrt{2E/m}}$ and $u_0 = \frac{\alpha\gamma_0}{4k}$ in which $\alpha = \frac{4\pi\sqrt{2mE}}{h}$. This formula has been shown to closely agree with the experiment. From our theory we also obtain an interesting formula for the critical radius of emission, *viz.*,

$$\gamma_0 = \frac{9}{64\pi} \cdot \frac{hv}{\alpha z^* e^2} = \frac{9}{64\pi} \cdot \frac{h^2}{4\pi m z^* e^2} \quad ..(2)$$

being independent of the velocity of emission as it should be. It is, however, inversely proportional to the effective atomic number z^*. This appears quite natural when it is remembered that the packing of the nucleus increases with z^* and so the emission is likely to take place even from a smaller γ_0. For radium emanation Equation (2) gives $\gamma_0 = 1 \cdot 2 \times 10^{-15}$ cm.

On the other hand, with decreasing z^*, γ_0 increases and so the density of matter within the nucleus decreases. Ultimately a limit is reached when the damping coefficient or, in the language of wave-statistics, the viscosity of the corresponding phase space becomes vanishingly small and there is no longer spontaneous disintegration. Let us take the case of hydrogen, for which Equation (2) gives $\gamma_0 \sim 10^{-13}$ cm. There being no spontaneous disintegration in this case, the critical γ_0 should correspond to the size of the hydrogen nucleus consisting of a single proton. It is significant that γ_0 thus obtained is exactly of the right order for a free proton.

We shall conclude with a few remarks on the parallel wave-mechanical theories given by Gamow, Sexl and others. It may be noted that they do not obtain any expression for the critical radius of emission corresponding to the wave-statistical Equation (2). However, their equation for the disintegration constant is more or less similar to our equation (1). The important difference arises on account of their dropping the unknown constant which should involve the unknown normalising factor and some other unknown constant. They define $\lambda = \frac{G}{\tau}$, where G is the transmissibility and $\tau = \frac{2\gamma_0}{v}$, v being the velocity. It, however, appears to us that within the hard core τ can only be proportional to $\frac{2\gamma_0}{v}$ and not equal to it. This explains the latter constant. That the normalising factor has been dropped is evident from Sexl's rigorous treatment of the problem in *Zeit. f. Phys.*, **56**, p. 62, 1929 and **81**, p. 163, 1933.

K. C. KAR.
A. GANGULI.

Physical Research Laboratory,
Presidency College,
Calcutta,
March 26, 1934.

The Effect of Magnetic Field on Streams of Charged Particles.

ABOUT three months ago I announced the results of some of my observations on the effect of magnetic field on charged particles in motion. A short press report of this work was published later on in several newspapers in different parts of India on or about the 22nd January 1934. The following is a summary of some of those results obtained by me :—

(1) I observed that streams of fine gas bubbles evolved during electrolysis, which rose vertically upwards, were deflected by a magnetic field in a direction at right angles to the field. The direction of this deflection was reversed by reversing the magnetic field, and the extent of the deflection was found to depend upon the strength of the field. The deviation was different in the case of different gases evolved during the electrolysis of several solutions. Thus, during the electrolysis of sulphuric acid the bubbles of hydrogen gas were deflected in one direction and those of oxygen in the opposite direction, thus indicating that they were oppositely charged.

(2) Streams of hydrogen gas bubbles evolved during the decomposition of acids by metals like zinc, which is a purely chemical reaction, were not appreciably deflected by the magnetic field; but when a pure zinc piece with a copper wire wound round it was immersed in sulphuric acid, there was an immediate evolution of hydrogen gas bubbles, which were certainly deflected by the magnetic field. Thus in the cases examined by me so far the gas bubbles evolved during purely chemical reactions were not charged, whereas those liberated during an electrochemical reaction were electrically charged. I am at present making a systematic study of the effect of the magnetic field on the gas bubbles evolved in reactions of different types, and I expect that the results will throw light on the nature of these reactions.

(3) Further, I have found that streams of charged colloidal particles moving under the influence of an electric field were also deflected by a magnetic field, the direction of deviation depending upon the charge of the particles.

The fact that charged particles like the electrons, α-particles, etc., are deflected has been well established by the classical researches of Sir J. J. Thomson and others, and the idea underlying the above-mentioned observations of mine is therefore not altogether new. Nevertheless, the interest in my observations perhaps lies in the extension of the idea to the case of the charged colloidal particles, gas bubbles, etc., and particularly in the application of the phenomena observed by me to a number of important problems in modern physical chemistry. A short account of some of these applications is given below.

One of the applications is in the determination of the mass of the individual charged particles in colloidal solutions, suspensions, etc., by measuring the deflection of these charged particles as observed in an ultra-microscope under the simultaneous action of electric and magnetic fields. From a knowledge of the extent of deflection, the intensity of the applied fields and the charge of the particle, which is determined separately, the mass can be easily calculated. I am at present busy developing this technique. An account of the results will be published in the near future.

Another application is to the separation of diplogen (heavy hydrogen) from ordinary hydrogen—a problem which is receiving much attention at present. The method which I have adopted is as follows:—In the electrolysis of water containing an acid or an alkali the electrode at which hydrogen was evolved was made of a fine platinum wire, fused into one end of a narrow glass tubing so as to expose only a very small portion of it to the solution, and conditions were so adjusted as to give gas bubbles of practically uniform size. When the electric current was passed, a fine stream of bubbles was found to ascend upwards, but when the magnetic field was also applied the stream spread out into different streams. I believe that I have thus been able to separate diplogen from ordinary hydrogen. I am at present repeating these experiments under the most suitable conditions so as to confirm these results. The importance of such a method is obvious since, apart from the theoretical interest, it furnishes us with an easy method of obtaining diplogen in a pure state and in a short time.

A detailed account of these experiments will be shortly published. I have already communicated a note on these observations to Professor F. G. Donnan, C.B.E., F.R.S., (London) and to Professor The Svedberg (Upsala) two months ago. Owing to several interruptions in my work I have not been able to complete it earlier.

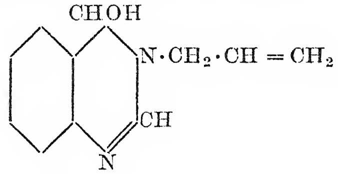
K. KRISHNAMURTI.

Chemical Laboratories,
College of Science,
Nagpur, C.P..
March 28, 1934.

Vasicin and Peganin.

IN a recent paper (*Ber.*, 67, 45, 1934) Späth and Nikawitz have advanced the constitution I for an alkaloid, peganin,

isolated from *Peganum Harmola* which bears a striking resemblance to vasicin II. Späth and Nikawitz have drawn attention to the possibility of peganin being identical with vasicin but since peganin could not be isomerised by alkali (as vasicin can be), they have left the question open.



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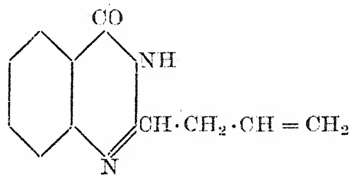


II

The main evidence on which the Späth-Nikawitz peganin formula rests is its oxidation to 4-oxyquinazoline 3-acetic acid whilst vasicin furnished 4-oxyquinazoline under similar conditions.

A sample of vasicin which was left for 2 years on examination has been found to have been considerably lowered in m.p. due no doubt to oxidation. Therefore, the question arises whether a similar partial oxidation could not have occurred in the isomerisation experiment described by Ghosh *et. al.* (*J.* 1932, 2740). Against this we have to contend the fact that *iso* vasicin does give a *hydrochloride* m.p. 222° considerably higher in m.p. than vasicin hydrochloride and a mixed m.p. also shows considerable depression. However, we are investigating this point further.

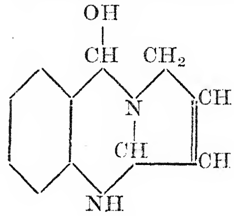
The structure for peganin was also considered by us for vasicin but was rejected on the following grounds:—

(*a*) Vasicin like many 4-oxyquinazolines remains dissolved in alkaline solution and is not precipitated till acidified with acetic acid. This is incompatible with structure I.

(*b*) Vasicin on interaction with acetic anhydride gives an acetyl derivative which is formed with the loss of a further molecule of water. On the basis of structure I such a dehydro-acetyl derivative cannot be formulated.

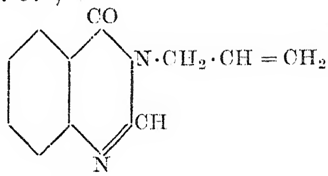
It is worthy of note that the acetyl derivative of peganin has been found to be an oil (*cf.*, Späth and Nikawitz, *loc. cit.*). This fact also points to the two alkaloids being different. If so, then it is most interesting to note how closely allied they are.

But on the basis of structure II, the formation of 4-oxyquinazoline 3-acetic acid can be explained if it is assumed that oxidation takes place *via* the intermediate III.



III

In order to verify the structure for peganin (I) we have recently prepared the substance IV, m.p. 67°,



IV

by the interaction of allyl iodide with 4-oxyquinazoline in alkaline medium. Following Bogert, the substance has been formulated as a N-alkyl and not an O-alkyl ether because it is undecomposed by boiling hydrochloric acid at 110° and also is non-volatile in steam (*cf.*, Bogert and May, *Jour. Amer. Chem. Soc.*, **31**, 508, 1909). Moreover another low melting substance is formed in the reaction which undoubtedly is the O-ether. The low m.p. of the substance is against the structure I for peganin.

Moreover, if peganin had been identical with vasicin, then the oxidation of this substance with hydrogen peroxide in acetone should give the two products, m.p. 168° and 212° isolated from vasicin under the same conditions. We have found that IV can be isolated entirely unchanged when oxidised by hydrogen peroxide in acetone under the conditions described by Ghosh *et. al.* (*loc. cit.*).

The reduction of the substance IV with amyl alcohol and sodium has given a substance B.P. 105-110°/3 mm. but unlike the very similar product from peganin (m.p. 69°·5) we have not yet been able to obtain it in a crystalline condition. Therefore, again, it seems that it is doubtful if peganin can be represented as I. We must state that the substance has a very characteristic odour reminiscent of the mother liquors in

the purification of crude vasicin which probably is also what Späth and Nikawitz mean by 'a characteristic odour'.

Our investigation would be published elsewhere in a more detailed form.

K. S. NARANG.
J. N. RAY.

The University,
Lahore.

The Effect of Germination on the Reducing Power of *Phaseolus mung*.

SINCE the discovery that Szent-Györgyi's hexuronic acid or ascorbic acid is identical with vitamin C, the reducing property of ascorbic acid has been sought to be used as a measure of the vitamin C-content of natural food-stuffs.[1] The presence of other naturally occurring reducing substances like glutathione might be supposed to interfere with the specificity of this method of chemical assay. But substantial evidence[1] has been brought forward to show that this method is a fairly accurate one for nearly all the food-stuffs studied. It is known that vitamin C is produced during germination and that germinated *mung* (*Phaseolus mung*) is rich in vitamin C.[2] We have found that germination does indeed cause a six-fold increase in the reducing power of *mung*, calculated on the basis of dry weight. The reducing value was determined by titrating trichloracetic acid extracts of the germinated and ungerminated *mung* against 0·01 N Iodine as well as against the oxidation-reduction indicator 2 : 6-dichlorophenol indophenol (0·01 M). Harris and Ray[3] have also observed an increase in the reducing power of peas on germination. Johnson[4] has observed, however, that this increase in the reducing power of germinated peas is out of proportion to the increase in antiscorbutic potency and concludes that a reducing substance besides ascorbic acid is produced during germination.

In estimating the reducing power by means of the indophenol indicator according to the technique of Tillmans, as modified by Birch, Harris and Ray,[1] it has been found that even dilute trichloracetic acid (0·5%) by itself decolorises the indicator. This decolorisation can be inhibited by the addition of glacial acetic acid to the indicator solution prior to titration by the trichloracetic acid extract. By means of this titration technique, a sample of red chillies has been found to have a reducing power of at least the same order as Hungarian paprika.

B. C. GUHA.
A. R. GHOSH.

Biochemical Laboratory,
Bengal Chemical &
Pharmaceutical Works, Ltd.,
Calcutta,
March 7, 1934.

1 Harris and Ray, *Biochem. J*, **27**, 303, 1933; Birch, Harris and Ray, *Biochem. J.*, **27**, 590, 1933.

2 Wats and Eyles, *Ind. J. Med. Res.*, **20**, 89, 1932.

3 Harris and Ray, *Biochem. J.*, **27**, 580, 1933.

4 Johnson, *Biochem. J.*, **27**, 1942, 1933.

Current Science and the Indian Academy of Sciences.

IN view of the recent publication of certain disputatious statements in the press regarding the institution of an Indian Academy of Sciences and the totally unexpected and embarrassing trend which the affairs have assumed, the Board of Editors, *Current Science*, desire to announce that the Journal, having taken the initiative in the proposal to establish such a foundation, now stands aside in a spirit of detachment. It will not lend its support to any movement which is apt to produce a factious spirit among the scientific workers, which must be absolutely fatal to the fundamental cause of progress in India. The policy of the Journal is to follow and promote peace, and in pursuance of this declared object, it will seek for opportunities to establish good understanding in all endeavours calculated to advance the higher destinies of science.

This policy of the Journal does not, however, impose restraints on the freedom of action on the part of the individual members of the Editorial Board as also those of the Board of Editorial Co-operation who may desire to participate in any particular movement and if and when they do so, they act either in their own private capacities or as members of some one or other of the scientific institutions favouring such a movement. The public utterances of such members or their action in the committees in which they choose to function, do not reflect the official views of the Journal.—ED.

Lt.-Col. R. B. S. Sewell, F.R.S.

CURRENT SCIENCE offers its hearty congratulations to Lieut.-Colonel Robert Beresford Seymour-Sewell on his selection as a Fellow by the Council of the Royal Society, London. He spent the best part of his life in India, first as an officer of the Indian Medical Service, later as the Surgeon Naturalist to the Marine Survey of India and finally as Director of the Zoological Survey of India; he went on leave preparatory to retirement from the 22nd April 1933. He was a member of the Editorial Board of the *Current Science* and gave us valuable help at all times and we are particularly glad to hear of his selection as a Fellow of the Royal Society, London.

Lt.-Col. R. Beresford Seymour-Sewell, M.A., Sc.D., F.Z.S., F.A.S.B., I.M.S., C.I.E., F.R.S.

Colonel Sewell has done very valuable work as a Zoologist, Oceanographer and Anthropologist and a detailed list of his papers was published in the *Records of the Indian Museum*, Vol. XXXV, pp. 270–275 (September 1933), while an account of his life was published in the *Current Science* issue for April 1933. We sincerely hope that the results of his investigations as the Leader of the John Murray Oceanographical Expedition will greatly add to our knowledge of the oceanography and fauna of the Arabian Sea.

Dr. L. L. Fermor, F.R.S.

WE record with genuine pleasure the election of Dr. L. L. Fermor to the Fellowship of the Royal Society. This has come as a fitting recognition of the long and devoted scientific labours of the present Chief of the Geological Survey of India. Dr. Fermor's connection with the Geological Survey dates from 1902 and throughout this long period, his work has been characterised by breadth of outlook and wide human sympathies side by side with mastery of detail and meticulous precision in the expression of scientific observations. Amidst his numerous contributions to Mineralogy, Petrology and Archæan Geology, perhaps the most outstanding work which will remain as a memorial to his ability and industry, is his monograph on the Manganese Ore Deposits of India dealing with every aspect, scientific and economic, of the subject.

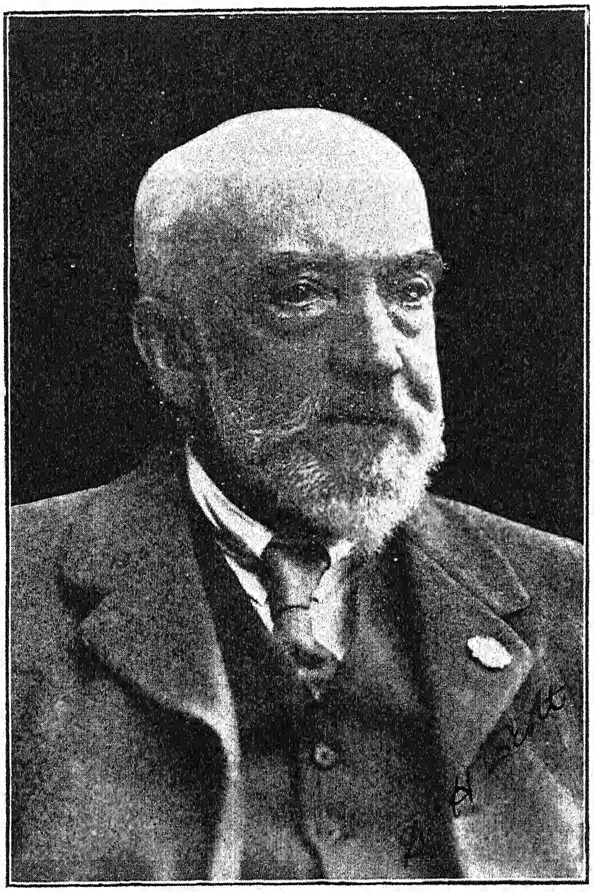
Dr. L. L. Fermor, O.B.E., D.Sc., F.G.S., F.R.S.

Dr. Fermor's social qualities are equally great; they find full play in his administrative duties, not only in his department, but also such institutions as the Asiatic Society of Bengal, of which he is the President, and of the Mining and Geological Institute of India, of which he is the Treasurer and Editor. A happy disposition, an even temper at all times and the capacity to understand and appreciate other points of view than his own, characterise his dealings with his official colleagues and non-official friends and acquaintances. We wish him long life and further honours.

Obituary.

Dr. Dukinfield Henry Scott.

DUKINFIELD HENRY SCOTT, F.R.S., died on the 29th January 1934 at the age of seventy-nine, after a remarkable career as an investigator spread over more than half a century. Born in London in November 1854 he was, till the time of his death, in full possession of his extraordinary vigour, producing, till as late as last year, work which involved a constant use of the microscope. For nearly thirty years after the death of Bernard Renault, he was the universally-acknowledged leader of the old anatomical school of palæobotanists, of which the foundations were laid just over a hundred years ago. With the passing of Dr. Scott is removed one of the last remaining links with the "old guard", who had helped the anatomical study of fossil plants to the high position it occupies to-day.



Apart from a few of his earliest works, which deal with the structure of living plants, Scott's original work lay entirely within the domain of Fossil Botany. After taking his B.A. degree at Oxford he worked for a Ph.D. for a couple of years under Sachs at Würzburg. In his dissertation, published in 1881, he described the development of laticiferous vessels and was able to show (without the use of a microtome) that they were formed by a fusion of specialised cells in the young tissues. His other notable works on living plants were a paper (with T. G. Hill, 1900) on *Isoetes* which confirmed the view that this aberrant genus is a reduced type of lycopod, without any special relationship to the ferns; and a slightly earlier paper (1897) on the vascular anatomy of the cone peduncles of the Cycadaceæ. In the latter, attention was drawn to the frequent occurrence of mesarch and concentric bundles; these fern-like features were till then known in the axial organs of only a very few living gymnosperms, though they had already been observed in several fossil types, such as *Lyginodendron* (now *Lyginopteris*), *Heterangium*, *Calemopitys* and others. Coming immediately after the Japanese discovery of ciliated sperms in *Cycas* and *Ginkgo* these facts seemed strongly to confirm the theory (which held almost undisputed ground until Scott himself relinquished it in 1919) that the Gymnosperms generally were derived from the ferns.

It was at Würzburg that Scott first met Goebel, of whom he writes: "I had a great regard for him from the first, both on his own account and because he was a pupil and ardent admirer of the great Hofmeister, who had long been my chief botanical hero." Those who have had the privilege of personal contact with both Goebel and Scott will appreciate the kinship as well as the contrast between these two leading spirits who, each in his own way, exercised such a marked influence upon the course of plant morphology. Botany has suffered sadly indeed to have lost both of them within about a year of each other.

It is a curious fact that practically the first that Scott had ever heard of fossil plants was, as he himself tells us, at Goebel's lectures at Würzburg; for Goebel, almost till the end of his life, evinced a strange antipathy against the study of fossils.[1] But it was not until ten years later that Scott seriously took to palæobotanical research. This was the prelude to that eventful though belated association with Williamson, who was already near the end of his brilliant career. Thenceforth, Scott was always "in the thick of it," and few have lived to witness such momentous developments in fossil botany or taken a more significant part in their shaping. That romantic quest after the "seed-ferns", and the question of their possible origin from the true ferns—in fact the origin of the seed-bearing plants as a whole—was the central pursuit of his long career, as it still remains one of the chief problems of Palæobotany to-day. In this, as in other directions, we are wiser now chiefly in a paradoxical sense: the progress of knowledge has but revealed our ignorance and the fallacy of our preconceived notions. In a remarkably frank statement published shortly after he had relinquished the idea of a filicinean origin for the seed-plants, he wrote: "It has been generally assumed, since Hofmeister's discoveries, that the seed-plants were derived from heterosporous Vascular Cryptogams......The idea got abroad that the Pteridosperms were ferns which had become Spermophytes.... The present writer is one of those responsible for this interpretation of the facts.... On a review of the evidence it appears that this view is unjustified." And then he goes on to explain: "It is easy to see how the current idea arose. We used to believe that half the Carboniferous plants were Ferns. Then it turned out that many or most of these 'Ferns' bore seeds. Yet we could not get it out of our heads that they were Ferns after all—they were so like them. We should have remembered 'that every like is not the same!'" Simplicity and directness of style was a marked characteristic of this great writer.

Latterly he was engrossed with the old question as to whether certain synangium-bearing fronds (*Scolecopteris*, *Acitheca*, *Asterotheca*) belonged to Marattiaceæ or, as Kidston was inclined to believe, to seed-bearing plants. The question had recently been brought up in a critical form by Professor Halle's discovery of seed-bearing fronds of *Pecopteris wongii*, a Chinese species almost identical with the well-known *Pecopteris miltoni*, which bears fructifications of the *Asterotheca* type. Till the end, Scott was impressed by the Marattiaceous resemblances of *Scolecopteris* (1932, 1933), though he did not regard the question as closed. It is, however, significant of the marked change of outlook since the discovery of the first undoubted Pteridosperms, that even *Psaronius*, a plant so completely fern-like in its anatomy, cannot now be regarded as quite above suspicion in this respect.

It is impossible here to attempt anything like a fair estimate of the influence of Scott's career upon the progress of palæobotany. His original contributions dealt chiefly with the anatomy of palæozoic plants. This was in itself a vast field, but his breadth of outlook was better evidenced by his masterly reviews of contemporary work; for he was an acknowledged leader in the art of reviewing the situation whenever anything new had happened. Like all cautious workers he was difficult to convince, and in this sense he was a conservative but, as we all know, by no means of the type that clings to pet theories.

Scott's numerous special memoirs, some of which were published jointly (with Williamson, F. W. Oliver, Jeffrey and others) ranged through nearly all the important palæozoic groups, and several will rank among the classics of palæobotanical literature. The "seed-ferns" naturally claimed the largest attention: *Lagenostoma* (1904) and *Trigonocarpus* (1907); *Sutcliffia* (1906), *Medullosa* (1899, 1914) and the Heterangiums (1917); lastly, the Calamopityeæ (1914, 1918, 1924).

Substantial advances were also made in the Cordaitales (1902), in which important resemblances were demonstrated with the Cycadofilices, particularly in the genus *Mesoxylon* (1910, 1912, 1918). One of the most interesting discoveries (1919) was that of the fertile shoots of *M. multirame* which were shown to be essentially a *Cordaianthus*, possibly bearing seeds of the type already known as *Mitrospermum compressum*. Shoots of a similar nature were recently described under the new generic name *Gothania* by Hirmer, whose work confirmed the identification of these shoots as a *Cordaianthus*. In

[1] I believe it was Hirmer, now in Goebel's chair at Munich, who softened the latter towards palæobotany.

one of his last papers (1933) Scott reverted to that peculiar Lower Carboniferous genus *Archæopitys* Scott and Jeffrey (1914) founded nearly twenty years previously and forming, with *Pitys* and *Callixylon*, a compact little group provisionally included among the Cordaitales. Mention should also be made of the problematical shoots *Cladites bracteatus* (1930) which may eventually turn out to be the fertile shoots of another member of the Cordaiteæ.

On the Zygopterideæ the most notable papers were those on *Botrychioxylon* and *Zygopteris* (*Ankyropteris*) *Grayi*, both published in 1912. It was Scott's work on *Botrychioxylon* that first clearly indicated the Ophioglossaceous affinities of this family, already long suspected. The genus has since turned out to be very closely allied, if not identical, with the old genus *Zygopteris* of Corda. Scott was the first to demonstrate the sporangia of *Stauropteris*, a plant which had long been a puzzle to palæobotanists but is now, probably rightly, classed among the Zygopterideæ, though still as an aberrant member. This was in 1905, during those exciting years when the seed-ferns were rapidly emerging into recognition. One after another, several supposed ferns had been proved to be in reality seed-plants: *Lyginopteris oldhamia*, *Neuropteris heterophylla*, *Aneimites fertilis*, *Pecopteris pluckeneti*; while a host of others were already under suspicion. With these discoveries as a background it is easy to understand the caution with which Scott concluded his remarks on *Stauropteris*: "On present evidence the systematic position of *Stauropteris* must remain an open question. That it shows affinities with the Ferns is certain, but it would not be surprising to find that, like so many other Fern-like plants of its period, it had crossed the Spermophytic frontier, so that its sporangia .... were in reality of the nature of pollen-sacs." Indeed, even to-day, if the truth must be confessed, the position remains essentially the same, for the petiolar anatomy of this, as of most other Zygopterideæ, is too distinct from anything we know among undoubted ferns to leave us in absolute security as to the real nature of these plants. Palæobotany is a veritable store-house of surprises, even for the wariest worker, as has been frequently witnessed during the life-time of D. H. Scott.

Special mention must also be made of Dr. Scott's memoirs on the spenophylls and on *Lepidocarpon*. In this direction, as in his work on the "seed-ferns", he proved a worthy successor to the great Williamson. The memoirs on *Cheirostrobus* (1897), *Lepidocarpon* (1901) and *Sphenophyllum fertile* (1905) bear testimony to his great skill in the elucidation of complex fossil structures, not often preserved under the most favourable conditions. At one time Scott shared the view (for which he was himself largely responsible) that the modern Psilotaceæ were the nearest known relations of the sphenophylls. But we all know the reaction which the Rhynie discoveries brought about in his attitude on this question.

It is difficult to say whether Scott's work was great chiefly on account of his brilliant expositions of the structure of extinct plants or because of his more general, synthetic, writings in which, with the skill of a great painter, he recorded from time to time the repercussions of current work upon the theoretical background of Palæobotany. But all will agree that he was a writer with a rare gift, which he displayed alike in that elementary text-book, "Structural Botany" as in his classical "Studies in Fossil Botany" undoubtedly his greatest work. In "Extinct Plants and Problems of Evolution" (1924), an authoritative summary remarkable for its clarity and perspective, are recorded what may be taken as his latest views on the broader questions of phylogeny.

Scott was not a voluminous writer, but his writings had the impress of sound judgment, based upon a strict adherence to

facts. He has left a fine monument of original work, which he built nobly, in the true spirit of Science, with no claim to finality. There is a certain element of triumph in a bold recantation of long-cherished ideas, and that triumph probably

few men of Science knew better how to win than Scott. The following words of Alexander Pope, which Dr. Scott was fond of quoting, truly describe his own attitude of mind:

> "And spight of pride, in erring reason's spight,
> One truth is clear; whatever *is*, is *Right*.'

Of his personal qualities, and of the reminiscences of the 'grand old man', let the elders speak, for that is their privilege. This little sketch is a slight tribute from one who, working in distant isolation, received from him much kindness and inspiration in a field of research which he so richly adorned.

The portrait is reproduced from a photograph dated Liverpool, September 1923. The snapshot, with G. R. Wieland on the left, was taken at Cambridge in August 1930, on the occasion of the Fifth International Botanical Congress. Those who attended the Palæobotanical Section under the inspiring presidency of Dr. Scott will recall happy memories of an unusually successful meeting.

B. SAHNI.

Lucknow, India,
March 1934.

An Automatic Electric Tower Clock Made in India.

By Dr. H. P. Waran, M.A., Ph.D., D.Sc., F.Inst.P.
Presidency College, Madras.

THE science of Horology (clock making) is one of those departments of applied physics which has had scant development in India. May be, it is because of a belief that it is a specialised line to which large industrial concerns have devoted themselves on mass production lines in the West and hence out of reach of small-scale individual effort. However, the fact remains that it is a subject receiving no attention whatever at the hands of our routine laboratory physicists. This is really deplorable as a physics laboratory and the average workers in it can contribute so much to the science of horology if only they will turn their mathematical, experimental or technical resources to this fascinating and useful study.

The work on large clocks of the type put up on towers for supplying accurate time to the public does certainly border on heavy engineering. But the smaller sizes of such clocks are certainly not beyond the capacities of any average physics laboratory equipped as most of them are with a workshop for the repair and manufacture of scientific instruments. The average physicist, however, seldom realises how interesting the design and construction of such clocks can be and what excellent opportunities there are in this domain for the exercise of all his faculties. Even if one considers only the single factor of costs the very large savings one is able to effect in these days of economy by making the clock oneself ought to recommend such activities to institutions in need of such services. At a modest estimate the saving works out at about 75% of the commercial quotation.

In recent years electricity coming to the aid of man has found extensive application in horology and many are the systems in vogue now by which large clocks are rendered quite automatic in action. One such clock of novel design, constructed at the Presidency College in 1930, has already established its reputation by its excellent performance for the last three years and it is shown in Fig. 1.

The clock has an illuminated dial six feet in diameter the frame being of cast iron one inch thick with a central star shaped webbing to stand the heavy wind thrust in the exposed situation right opposite the sea. The panels are filled with plate glass $\frac{1}{4}''$ thick frosted and painted inside with white enamel to get a translucent finish. The hands are of ribbed aluminium casting $\frac{1}{8}''$ in thickness and four inches wide each weighing about 2 lbs.

The interesting novel features incorporated in the design of this clock are the following indicated in Figs. 2 and 3 which are line drawings showing the circuit details for purposes of explanation only.

The isochronism of the pendulum is ensured by the employment of a gravity lever escapement Fig. 2. This being new to many physics people may require an explanation.

The driving weight of about 100 lbs. is urging the escape wheel W to rotate in the direction of the arrow and it is prevented

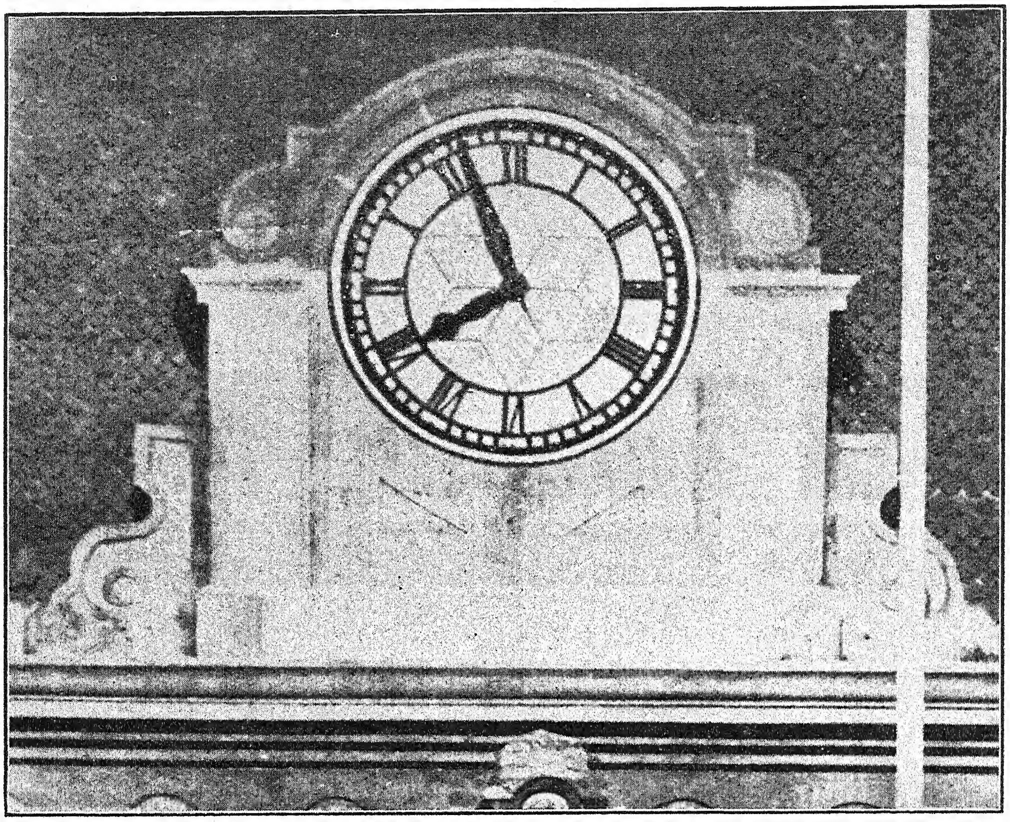


Fig. 1.

from doing so by its projecting tongue T resting against the steel check C, carried by the bent gravity lever L. The pendulum rod P moving in the direction of the arrow pushes out the gravity lever pivoted about Q until T escapes fast C. This rotation brings a steel pin R to press against a steel blade S carried by the gravity lever L. In this operation the driving weight lifts the gravity lever L and thus stores energy in it. When the pendulum returns this energy is given to the pendulum to keep up its arc of swing and ensure isochronism. There is symmetrical gravity lever L, on the other side of the pendulum for the same purpose.

The temperature compensation is automatically taken care of by the pendulum rod being of Invar. Its residual temperature coefficient has been carefully measured and compensated for by a small cylinder of aluminium supporting the 100 lb. cast iron bole twelve inches in diameter.

The noisy recoil of the escapement on impact against the arresting cheeks on the gravity levers is generally an objectional feature of this escapement. The recoil tends to reverse the train and the slight rolling action results in gradual wearing off the gear teeth. This is usually prevented to some extent by a large fan fly which makes the design cumbersome. In the present design it is taken care of by what may be termed an inertia wheel which being new to horological practice may require some explanation.

This is illustrated in Fig. 2 B and it is a small bronze fly wheel F about 4″ in diameter fitted loose on the escape wheel shaft S. Two springs r and r' from the rim of this wheel carry friction blocks of fibre B and B′ and they pinch the escapement shaft between them with adjustable friction. Now if the escapement is released and it tries to rotate rapidly the inertia of the wheel steadies it and prevents it acquiring a large angular velocity. On its sudden arrestment the wheel slips on its axle keeping a forward urge on the shaft so that a recoil of the

escapement is impossible. The improvement is markedly noticeable in the very much reduced noise at impact and the horrors of this noisy escapement which makes the adjoining rooms generally unusable are prevented. Because of this new device the usual wind vane or fly of about four feet diameter is absent and it enables the mechanism to be kept very compact.

The drive is by a gravity weight W of about 100 lbs. hung on to the loop of an endless chain going over an 8″ diameter sprocket wheel S keyed on to the minute hand shaft going round once in an hour as of the college tower, an automatic winding up of the weight every hour (after a foot fall) is arranged. This makes this design of clock particularly suitable for location inside the circular opening in the wall of a tower made for the large dial.

The automatic winding every hour operates as follows:—The falling driving weight W, has a projecting arm A, which after an hour of fall rests against a lever L and lowers its end E. The lever being pivoted (with some friction at the pivot) the other end E′ is raised and this end being coupled to lever F by a connecting rod R, the end F′ is raised

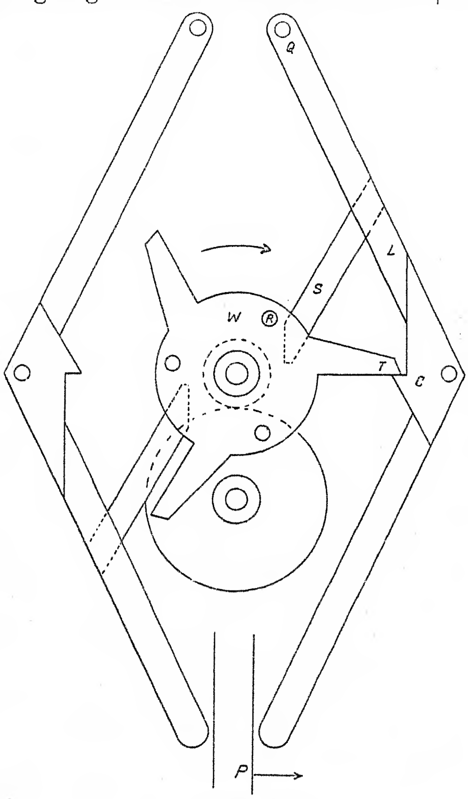


Fig. 2 A.

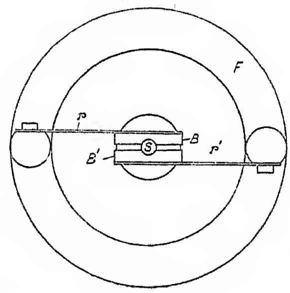


Fig. 2 B.

shown in Fig. 3. The other end passes round a sprocket Ś, keyed on to the shaft of a worm gear actuated by a ¼H.P. electric motor. The slack portion of the chain hangs outside as a loop carrying a small weight W′ to keep the chain tant. Because of this modified form of Huygens chain drive, not only maintaining power while the clock is being wound up automatically is ensured but also the arrangement permits of the maximum available fall being effectively utilised. This height being limited to about 4 feet which is all that is available in the window space and the end F lowered. This end carries a mercury switch and the mercury flows down to make contact between the two pools p and p' and starts the winding motor M. Since the motor is coupled to the winding sprocket by a double reduction gear of ratio 1 : 1200 there is ample reserve of power and the weight is smoothly wound up without any effort. The arm A coming up against the lever end F raises it and the mercury switch having gone fast the horizontal the excess mercury flows away breaking contact between the two mercury

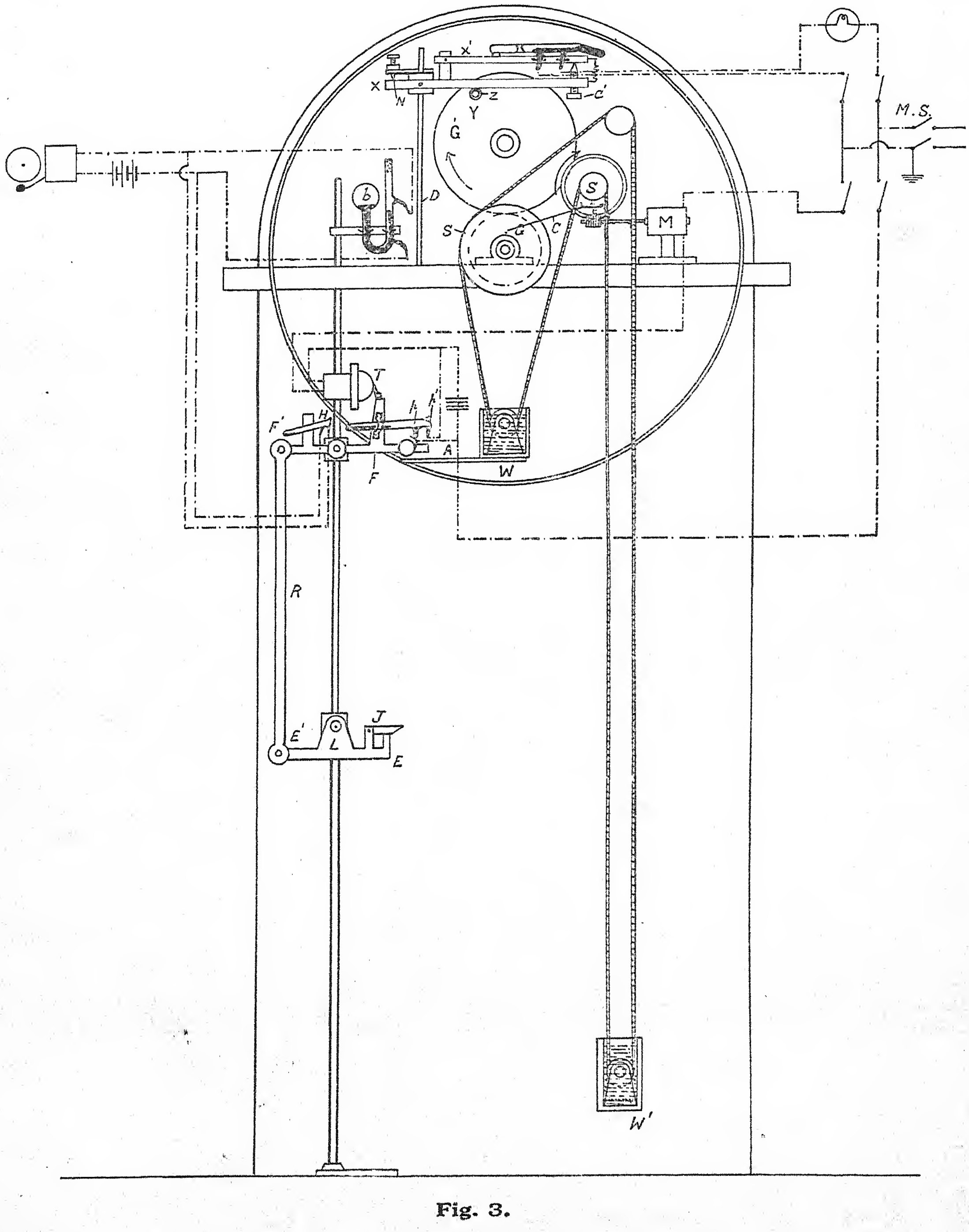


Fig. 3.

pools. This stops the motor. Thus the clock is quite automatic in action requiring nothing but a monthly attention for oiling and adjustment of any residual errors. Even this oiling is made automatic as the chain passes through oil baths in the driving weight and counterweight chambers. Every hour as the winding takes place the chain brings up oil to the winding sprocket S′. Dripping from there the oil is caught in a shallow tray *t* from which copper tubes lead the oil to the essential bearings.

The under dial system of gears to reduce the minute hand motion to the hour hand motion of 1/12 is made as a separate system of four gears running in an oil bath mounted on a separate girder. The coupling between the clock and this part is by a positive acting clutch of novel design. This facilitates not only the setting of the hands by minutes without stopping the clock but any difference of alignment between the two parts is also made innocuous at this flexible but positive drive existing at the clutch.

Provision is also made for the automatic lighting up of the dial at about 6 P.M. every day, the light being automatically cut off every evening at about 10 P.M. and thus save the lighting cost which is about ten times the winding cost. This is achieved as follows:—

The hour hand shaft that rotates once in twelve hours carries on it a gear G which engages with another gear G′ of double the number of teeth. This, therefore, rotates once in a day. It carries on its rim a roller Z round a pin Y. During the rotation of the wheel this roller comes up against a pivoted lever X carrying a mercury contact in the lighting circuit as shown. Normally the lever X rests against a screw point N which keeps it horizontal. This lever carries a subsidiary lever X′ which is the one carrying the contact. The screw C′ against which X′ rests enables adjustment of the mercury contact to be made. These are so made and the wheel G′ so set that as the roller comes up and raises the lever the contact is closed exactly at 6 P.M. As the wheel G′ rotates the lever is kept tilted up and the mercury contact is kept closed. The roller passes the highest point at 8 P.M. and by 10 P.M. the roller has lowered the lever to horizontal again breaking the lighting circuit. Thus the duration and time of lighting and cutting off are all adjustable to suit individual requirements.

It is interesting to note that this arrangement gives also an amount of automatic connection for the changes in the lighting up time with the seasons. In tropics at any rate where the magnitude of this is not very large it seems to work. The rod D carrying the switch lever changes in height with the change of temperature accompanying the seasons and to that extent it alters the time at which the contact closes. Thus in summer with the prevailing higher mean temperature the rod elongates enough to advance the lighting up time. The reverse happens in winter because of the lowering mean temperature.

Every such clock even though well designed and executed with every care must have incorporated in it many safety features if trouble is not to be experienced sooner or later.

Thus the mercury contacts may arc and overwinding may result with damage to the winding gear and motor. This is provided against by the knob of the main switch T being placed just above the lever F. If the lever rises beyond its set limit by the mercury contact arcing, the main switch gets thrown off mechanically. Precautions against such arcing or failure to make contact are taken by the contact being of the mercury type in an atmosphere of low pressure Hydrogen, shunted by large condensers to quench any tendency to arc.

Whenever the main switch (mechanical) thus gets thrown off by overwinding the increased inclination of the lever F results in the closing of a mercury contact—(not shown) which closes the circuit of an electric bell placed in the office below attracting immediate attention to this state of affairs. It could be looked into and repaired at once.

Another possible trouble specially to be guarded against in electric clocks run off public supply mains is that arising from the failure of the supply occasionally for a few minutes or hours. This is incidental to even the best of public supply systems and in the present design it is guarded against as follows. Failure of the supply for a few minutes is certainly of no consequence as the drive is by gravity weight. This failure may occur just when the arm A has lowered the lever E and the winding contact has not yet closed. The result is the lever A passes the lever E leaving it in the inclined position of contact made and using the reserve fall of about 3 feet the clock can still go on for three hours. During this the

power is sure to return and since the contact is left on the motor can wind up the driving weight. There is the provision of a passing lever J on E so that the arm A may go up lifting it and not E. The extreme inclination at which the levers are left closes a mercury contact at H which operates the electric bell down below calling attention to this state of affairs. The bell continues to ring until this situation is taken in hand. Since this warning is given full three hours before the clock has to stop there is ample time to effect repairs.

Since the mains have to be left alive day and night in such a clock tower it was thought advisable to instal an automatic fire alarm as well if ever the temperature in clock chamber rises beyond 50°C. This is done by the air contained in the bulb *b* expanding and closing the bell circuit again as indicated and the main switch M.S. supplying power to the tower could be taken off.

Provision is also made for this clock to switch on automatically the electric bells by which the class periods are signalled in the college now. The details of this together with the bell ringing for chiming out the time on a large bell are reserved for the next article.

Conversazione on the Occasion of the 150th Anniversary of Foundation of the Asiatic Society of Bengal.

THE Conversazione on the 15th January, 1934, in connection with the 150th Anniversary of Foundation of the Asiatic Society of Bengal was a brilliant function. It was held in the spacious upper verandahs of the Indian Museum which were divided into compartments to hold exhibits, and were illuminated by means of strong lights. Arrangements were also made for an At Home with Indian Music for about 500 guests on the lawn of the Museum. The guests were received by the President, Dr. L. L. Fermor, and Dr. S. L. Hora, the Secretary of the Jubilee Celebration Committee. A 'List of Exhibits' and a small pamphlet by Dr. A. M. Heron of the Asiatic Society of Bengal were handed to each guest. The exhibits were tastefully laid out and comprised all branches of Letters and Science. Through the courtesy of the Academy of Fine Arts, Calcutta, some fine paintings were on view and added a great charm to the other exhibits. The Imperial Records Department put up a series of old documents of great public interest. The Archæological Section of the Indian Museum and Dr. S. K. Chatterji exhibited a series of archæological finds, some of which constituted recent discoveries and were exhibited to the public for the first time. A numismatic exhibit was provided in the form of a show-case containing specimens of coins, medals and decorations struck at His Majesty's Mint, Calcutta. The Departments of Chemistry and Physics of the University of Calcutta gave some interesting demonstrations of certain chemical and physical phenomena, such as Brownian Movement, Active Charcoal, Wireless Echos, Dyes, etc. The Geological Survey of India exhibited palæontological specimens and of these the fossilised remains of Dinosaurian Reptiles deserve special mention. Mineral and Rock exhibits were also shown by the department. The Botanical Survey of India showed original paintings of plants by William Roxburgh, Wallich's Catalogue, coloured sketches of some plants under cultivation at the Royal Botanical Garden, Calcutta, and Narayanswami's manuscript of a comprehensive catalogue of references to all works dealing with Indian Botany. Dr. S. C. Law exhibited Habitat Groups of bird-life in Bengal, drawings of some Indian Birds and photographs of his wonderful aviaries at Agarpara. The Zoological Survey of India put up ethnographical and zoological exhibits of great interest, and the School of Tropical Medicine had some very instructive exhibits dealing with Protozoology, Helminthology, Entomology, Rabies, Bacteriology, Indigenous Drugs, Filariasis, Kala-Azar, Leprosy and Public Health. A most useful feature of the Conversazione was the presence of qualified demonstrators in each section enabling the guests to take an intelligent interest in the exhibits and to elicit more information, if desired, than what had been supplied to them in the 'List of Exhibits'.

The exhibits were thrown open to the general public for two days and were greatly appreciated.

Research Notes.

Induced Radioactivity.

IN the *Comptes Rendus*, **198**, p. 254 and p. 559, 1934, *Mme.* Iréne Curie and *M.* F. Joliot describe some extremely interesting experiments on the artificial production of new radioactive elements. They had previously found (*Comptes Rendus*, **196**, 1885, 1933) that some light elements such as beryllium, boron and aluminium emit positive electrons when bombarded by α-rays from polonium. According to their interpretation the positrons from beryllium must be due to the internal conversion of γ-rays into matter, whereas in the case of B and Al the positrons must be due to a process of transmutation accompanying the emission of neutrons. In the course of further study they discovered the interesting fact that the emission of positrons continued for an appreciable time after irradiation with α-rays had been stopped and that the intensity of this positron emission decreased exponentially, showing *different* periods, as in the case of the radioactive elements. The periods thus found were 3 min. 15 sec., 14 min., and 2 min. 30 sec., respectively for Al, B and Mg. The elements H, Li, C, Be, N, O, F, Na, Ca, Ni, Ag showed no such activity. In some of these cases there might be no activity at all, while in others the period is too short.

The explanation given by Curie and Joliot is as follows: in the case of Al the reaction represented by the equation

$$Al^{27}_{13} + He^{4}_{2} \rightarrow P^{30}_{15} + n^{1}_{0}$$

takes place, *i.e.*, the α-particle is captured by the Al nucleus resulting in the formation of P^{30} and emission of a neutron. The P^{30} nucleus is, however, unstable and disintegrates according to the equation

$$P^{30}_{15} \rightarrow Si^{30}_{14} + E^{+}.$$

The corresponding equations in the case of B and Mg are

$$B^{10}_{5} + He^{4}_{2} \rightarrow N^{13}_{7} + n^{1}_{0}\,;\ N^{13}_{7} \rightarrow C^{13}_{6} + E^{+}$$
$$Mg^{24}_{12} + He^{4}_{2} \rightarrow Si^{27}_{14} + n^{1}_{0}\,;\ Si^{27}_{14} \rightarrow Al^{27}_{13} + E^{+}.$$

In support of their explanation, Curie and Joliot have chemically proved the existence of Nitrogen and Phosphorus in the activated samples of Boron and Aluminium and they have also shown that the activity is due to the Nitrogen and Phosphorus thus proved to exist. This is the first time that a nuclear reaction expected according to considerations of energy has been chemically verified, since in previous cases of artificial disintegration, the process was instantaneous and gave rise to stable nuclei. The elements N^{13}_{7}, P^{30}_{15} and Si^{27}_{14} thus artificially produced and shown to be radioactive have been named respectively radio-nitrogen, radio-phosphorus and radio-silicon by the discoverers.

Very recently L. Meitner (*Naturwiss*, **22**, 172, 1934) has studied the transformation in Al by means of the Wilson camera and has shown that Al disintegrates in two ways under bombardment with polonium α-rays, *viz.*, according to the schemes

$$Al^{27}_{13} + He^{4}_{2} \rightarrow Si^{30}_{14} + H^{1}_{1} \quad \text{and}$$
$$Al^{27}_{13} + He^{4}_{2} \rightarrow Si^{30}_{14} + n^{1}_{0} + E^{+}$$

which is the one considered above.

Meitner has also shown that the frequency of the first of the above kinds of transformation is about four times that of the second.

Endocrine Control of Ovarian Functions.

C. W. BELLERBY (*Biochem. Jour.*, **27**, No. 6) has substituted very profitably *Rana temporaria* and *Xenopus lœvis* in place of mammals for determining the action of the pituitary extracts on the activity of the Ovary. It is noticed that in the two amphibians, the pituitary is easily accessible. In the first place alkaline extracts of the anterior lobe pituitary have the same effects as acid extracts. This is a fact of some importance as it has till now been assumed that there are two distinct substances in the extracts which perform two different functions, *i.e.*, follicular growth and luteinisation. It is on the other hand more likely that we are dealing with a single substance which produces results apparently antagonistic. Bellerby is inclined towards the latter hypothesis.

Urinary Excretion of Vitamin C.

THE paper by L. J. Harris, S. N. Ray and A. Ward (*Biochem. Jour.*, **27**, No. 6) has probably great applications for dietetics. By the titration method with 2 : 6 dichlorophenolindophenol they have demonstrated the presence of vitamin C in human urine and have found that in normal individuals, the daily loss of vitamin C in urine is about 30–33 mg. which is really a little greater than the reputed quantity required by man. It is interesting to note that in the case of

an individual who has imbibed a single large dose of vitamin C (about 600 c.c. of orange juice) the concentration of vitamin C in the urine rises very rapidly reaching in about three hours the maximum, which is nearly 10 times the normal. A rapid fall ensues and even if the subject is kept free from vitamin C diet for a week or more, the daily quantity of about 33 mg. is maintained.

Germination of Seeds.

The influence of electrolytes and non-electrolytes on germination and the subsequent development of seeds is a fascinating subject which is just attracting the attention of plant physiologists. I. A. Volkov (*Bull. Appl. Bot. Gen. Plant Breeding*, III Series, No. 3, p. 131, 1933) has investigated the influence of sugar solutions and glycerine in the germination of different seeds of agricultural importance. In *Avena byzantina* the several phases were accelerated by more than a week, increasing simultaneously the dry matter content. The strongest effect was noticed in solutions of 0·4 N sucrose and 0·5 N glycerine. The effect is less marked with wheat, while the stimulating action on the flax seeds was practically nothing. The author concludes that one of the factors which accelerate reproduction in the cereals is the accumulation of sugars. The seeds of oleiferous plants germinate equally well in water and in glycerine.

Drought Resistance in Fruit Trees.

Water supply is one of the chief factors controlling plant growth. In the absence of moisture in the soil, the development of plants is enormously modified leading finally to their death. But it often happens that the soil holds moisture in insufficient quantities, leading to a condition, known as soil drought. The capacity of plants to grow in such cases is varied. An interesting contribution on the ability of fruit trees to withstand such drought has been made by A. Richter (*Bull. Appl. Bot. Gen. Plant Breeding*, III Ser., No. 3, p. 189, 1933). The author has adopted the wilting method successfully wherein the plants are kept at the hygroscopic moisture content of the soil for 8–10 days, and subsequently allowed to recover. Different plants lose different amounts of moisture under such treatments. The author tried the peach, the plum, the prune, the apricot, the cherry, the fig and the almond plants.

Striking morphological adaptations are noticed in the foliage of those plants. In one set, consisting of the peach, plum, apricot and some varieties of prunes, the leaves are found to withstand considerable moisture deficiency, without exhibiting any diminution in the transpiration surface, in such a case it is but natural that the rate of transpiration is considerably lessened. In the other set, comprising of the almond, the fig, the sweet cherry and one variety of prune, the foliage cannot support such a deficit and consequently the leaves drop off decreasing the transpiration surface enormously—a feature which is so common in the desert plants. The manifestation of either of this property is little influenced by the developmental phase of the plant either vegetative or resting.

The author has arranged as follows the stock of the fruit trees examined in the order of their resistance to soil drought: (*a*) the most resistant—the fig, the almond and the peach; (*b*) less resistant—a variety of prune, *Prunus Mahaleb* and the sweet cherry; (*c*) poorly resistant—*Prunus divaricata*, *P. spinosa* and the plum; and (*d*) highly susceptible to drought—the apricot.

The significance of such studies cannot be ignored for a tropical country like India, where the weather conditions are so varied.

Classification, Bionomics and Evolution of Homalopterid Fishes.

Dr. Sunder Lal Hora has made a signal contribution to our knowledge of the fishes of India by bringing out his extensive monograph on the Homalopterid fishes (*Memoirs of the Indian Museum*, **XII**, No. 2. pp. 263–330). Much of his recent work has centred round the extensive examination of torrential and mountain-stream-dwelling fauna and Homalopterid fishes constitute an important portion of this fauna. The first part of this work deals with the classification of the family where all the species have been described. The family is divided into two sub-families—Homalopterinæ and Gastromyzoninæ. There are six genera in the first sub-family and eleven in the second. The diagnostic characters of all the genera are tabled and they will doubtless prove of valuable assistance to every worker on Homalopterids. Several new genera have been described by the author,—Protomyzon,

Annamia, Sewellia, Vanmanenia and Beaufortia.

The second part of the work deals with the bionomics and evolution of the family. On account of the peculiar habits of these fishes which live in fast-flowing mountain torrents, clinging to rocks, several interesting modifications have arisen; the body has become flattened dorsoventrally, the scales on the under-surface have become reduced or are completely absent, and the paired fins have become modified in a remarkable manner to aid in the adhesion of the animals to the substratum. It is noticed that these modifications have arisen independently in the two different sub-families, consequent on the assumption of the habit of living in the fast-flowing torrential streams. The respiratory and feeding mechanisms are remarkable, having been modified to suit the peculiar environment.

The Hyoid and Larynx of the Anura.

THE study of the amphibian larynx has been engaging the attention of workers from a long time and very recently W. Blume extended our knowledge on the microscopic anatomy of this structure in anura by publishing an exhaustive contribution in *Morph. Jahrb.* (Dec. 1930). No doubt this subject is a very fascinating study. Since the variations noticed in this extremely plastic structure are so many, we may not be correct in taking into account the morphology of this structure for purposes of classification of this group. The latest contribution to the gross anatomy of the larynx and hyoid is by Miss E. Trewavas (*Phil. Trans. Roy. Soc., Lond.*, B. 222, 1933) whose paper fills a large gap in our knowledge of the comparative anatomy of the larynx. She has studied many genera belonging to the different orders of the group anura and has given a comprehensive account of the larynx and hyoid apparatus in them including the South American form *Leptodactylus ocellatus*, which she treats as a generalised form. The description given for this and also for that of *L. prognathus* closely corresponds to that given for *Rana* by previous workers. In the other species of *Leptodactylus*, *viz.*, *L. caliginosus*, the cricoid annulus is incomplete ventrally with the low cardiac process separated by a gap. Moreover, the œsophageal process is exceedingly short in the female.

Similar variations both in the disposition of the muscles of the hyoid and the structure of the larynx have been described in other forms. Describing the group Pelobatidæ the author reports that the hyoid musculature resembles very closely the generalised Leptodactylid or Ranid type and supports the thesis that Pelobatidæ marks a distinct advance over the Liopelmidæ and Discoglossidae. Further, the incompleteness of the cricoid annulus among the Pelobatid examples studied by Miss E. Trewavas recalls the condition in some species of Leptodactylidæ. In *Rhacophorus dennysi* also, the same incompleteness prevails and it is surmised that this is a case of convergence of features. In one of the examples of the group Leptodactylidæ, *Crinia*, an intimate union of the cricoid annulus with the cartilaginous epiphysis of the posterior cornu of the hyoid is described. This feature is also noticed very pronouncedly in the examples of the group Brachycephalidæ and to a much less extent among the species of Bufo. An examination of both *B. himalayanus* and the more common *B. melanostictus*, will reveal that, at the outset, the union is not so close in these Bufonid examples as in the Brachycephalidæ but to a lesser extent. It is easier to remove the larynx from the fork of the posterior cornu of the hyoid in *B. melanostictus* than in *B. himalayanus*. On page 455, the author while describing the larynx of Bufonid examples gives under the title of *Bufo himalayanus* four sectional views of the larynx of the metamorphosing toadlet. In a footnote on the same page she reports about the sections thus, 'They were labelled *B. melanostictus*, but since the specimen came from India, they are more probably *B. himalayanus*.' This is not so, for the more commonly distributed form throughout India is *B. melanostictus* and Boulenger points out that *B. himalayanus* is restricted to Himalayas (Nepal and Sikkim).

The vocal organ of the examined species of *Rana*, *Megalixalus* and *Rhacophorus* is built on a common plan. They all possess the apical cartilage though not in many cases separately, from the arytenoids. The shape of the cricoid varies among the many species of *Rana* but invariably the females are characterised by the possession of the œsophageal process. No doubt there are certain exceptions as for example the males of *R. greyi* and some specimens of *R. breviceps* that are endowed with this process.

The separation of Cacosternum from the Brevicipitid group and its treatment under

a separate category is thoughtfully done. We learn from a study of the cranial osteology that this animal could no longer be brigaded under the Engystomatidæ and should be more correctly treated under Ranidæ. Most of the characters described for the group Brevicipitidæ have already been given in a paper published in the *Half-Yearly Journal of the Mysore University* (L. S. Ramaswami, *Journ. Mys. Uni.*, **6**, No. 1, 1932). The peculiar possession of a bony or cartilaginous median portion of the hyoid, the absence of the apical cartilage and the œsophageal process, the peculiar expansions of the terminals of the broncheal process have already been noted. At any rate, the absence of an omohyoid, the presence of only two petrohyoidei muscles are new. Except Hemisus and Breviceps, there seems to be a fundamental unity of characters underlying all the members of the Brevicipitidæ.

There still remains a large number of genera to be examined and the histological details would be extremely interesting and perhaps might reveal many new features.

L. S. R.

The United Provinces Grid.

THE further installations of low-head, slow-speed, vertical propeller type turbines at Bahadrabad and Bhola Falls in the Ganges Canal and the speculative proposition of harnessing the Sarda Canal for electrical energy purposes, to complete a grid, spreading all over a purely agricultural province with hardly any concentrated industrial loads has fulfilled the expectations of the Government in the direction of rural electrification. The existing Ganges Canal hydro-electric scheme started in 1928 has succeeded by 1931 in exploiting the water power resources of a number of low head falls to the extent of 5700 KW, which was continually going to waste in the irrigation canals of the province. The canal is 163 miles long between its head-works at Hardwar and Sumera Falls—the last fall in the Canal. The country has an average gradient of one foot per mile and this slope has been absorbed in a series of thirteen falls of heights ranging from twenty to nine feet. The ultimate total capacity when the scheme is completed will be about 30,000 KW. The four falls out of these have been harnessed as follows:—

No.	Distance from Head-works (Miles)	Generating Station	Head used (feet)	No. of turbine sets	KW.	Quantity of water required (Cusecs)
1	7	Bahadrabad Falls	19	4	2400	4000
2	84	Bhola Falls	15	4	1500	1700
3	148	Palra Falls	8	3	600	1200
4	163	Sumera Falls	14	2	1200	1000

The transmission grid includes these four generating stations, about 1000 miles of h.t. lines and 90 transformer stations and it has been so interlinked that uninterrupted and efficient service can be maintained even when there is a shut down of any one station. The energy is consumed by (1) the districts of Bijnor, Moradabad, Sahranpur, Muzaffarnagar, Meerut, Bulandarshahr and Aligarh; (2) Pumping stations at Ramganga and Kalinadi for pumping 300 cusecs of water to irrigate 80,000 acres of land; (3) Agricultural and rural industrial loads. The main transmission voltage is 37 KV. and also includes a portion of double circuit. The branch lines operate at 11 KV. and they have cost Rs. 8,800 and Rs. 4,000 per mile respectively and still cheaper rural lines are being erected and they compare favourably with lines of similar capacity hitherto constructed elsewhere. In the design of the grid, allowances have been made for future growth of load. The distribution has been left to the private companies. In spite of this elaborate network, this scheme is serving a total urban population of 952,000 at a sufficiently cheap rate and even cheaper to the rural industries. The novel engineering feature of the enterprise is the installation of generators on the existing foundations instead of on a detached one which has considerably reduced the initial expenditure. The total capital cost amounted to about Rs. 150 lakhs and the gross revenue has increased from Rs. 7½ lakhs in 1932 to Rs. 10 lakhs in 1933.

Another distinctive feature of this scheme is that it will incur additional capital expenditure only when a corresponding guaranteed demand arises. If need be, a similar scheme may be successful in later years in harnessing the Jumna Canal.

T. D. CHATTERJI.

Science News.

New Fellows of the Royal Society.—We are glad to announce that Dr. L. L. Fermor, O.B.E., D.SC., F.G.S., Director, Geological Survey of India, and Lt.-Col. R. B. Seymour-Sewell, M.A., SC.D., F.Z.S., F.A.S.B., I.M.S., C.I.E., Leader of the John Murray Expedition to the Arabian Sea, formerly (1925-33) Director, Zoological Survey of India, have been elected Fellows of the Royal Society. Both the distinguished scientists are on the Board of Editorial Co-operation of *Current Science* and we offer them our felicitations for the well-merited distinctions they have won.

* * *

Fellows of the Royal Society of Edinburgh.—Dr. R. M. Gorrie, Forest Research Institute, Dehra Dun, U.P., Prof. A. R. Normand, Department of Chemistry, Wilson College, Bombay ; and Prof. R. K. Pal, Professor of Physiology, Prince of Wales Medical College, Patna, have been elected Ordinary Fellows of the Royal Society of Edinburgh at its meeting held on the 5th March 1934.

* * *

Back Grant Award.—The Royal Geographical Society, London, announces the Back Grant Award to Mr. D. N. Wadia for his studies on the geomorphology of the Himalayan regions. Mr. Wadia's researches have already earned for him numerous distinctions and we hope that greater honours are in store for him.

The Royal Geographical Society has awarded a medal to Mr. Hugh Rutledge. We have pleasure in offering our felicitations both to Mr. Wadia and to Mr. Rutledge.

* * *

International Congress of Radiobiology.—Sir C. V. Raman, Kt., F.R.S., N.L., Director, Indian Institute of Science, Bangalore, has been invited to deliver the Inaugural Address at the First International Congress of Radiobiology which will be held in the historical palace of the Doges of Venice (Italy) on the 10th September.

The Council of the Indian Institute of Science have sanctioned Sir C. V. Raman being placed on special deputation out of India for this purpose. Dr. Raman will visit some of the chief centres where Research work on atomic disintegration is being carried out.

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President of the British Association, 1934.—At the recent meeting of the General Committee held on the 2nd March, Sir James Jeans has been elected President of the British Association. He will preside over the meeting which will be held at Aberdeen in September.

* * *

The Budapest International Fair, 1934.—The Fair will be held this year from the 4th to the 14th May under the auspices of the Budapest Chamber of Commerce and Industry. Firms intending to participate in the Fair may obtain full particulars from Mr. Eugen Ludvig, c/o Post Box No. 60, Madras, who is the representative of the Fair in India.

* * *

The Bangalore Easter Science Congress, 1934.—Under the joint auspices of the Association of Economic Biologists, Coimbatore, Indian Chemical Society (Madras Branch), Institute of Chemistry (Indian Branch), Society of Biological Chemists, India, and the South Indian Science Association, Bangalore, a Science Congress was held from 30th March to 2nd April, Sir C. V. Raman, Kt., F.R.S., N.L., presiding.

Delegates from Coimbatore, Madras and Travancore attended the Congress. Sir C. V. Raman delivered the inaugural address on "The Study of Scattering of Light in relation to Chemistry"—33 papers came up for discussion before the meeting. An interesting feature of the programme was the presentation of reviews of progress on selected subjects by specialists. Rao Bahadur Prof. B. Venkatesachar gave a brief review of recent advances in "Nuclear Physics"; Rao Bahadur B. Viswanath on "Some Physical and Chemical Considerations on Plant Nutrition and Growth," Dr. C. V. Natarajan on "Mutations of Bacteria" and Dr. B. L. Manjunath on "The Chemistry of Vitamins". Two public lectures, one on "Rice Work in Madras" by Mr. K. Ramiah and the other on "Optical Technology" by Prof. H. P. Waran, were also arranged.

By the kind courtesy of the Director of Agriculture in Mysore and the President of the Mysore Sugar Factory, Ltd., a visit was arranged to the Mysore Government Cane Farms and Sugar Factory.

Sir Venkata and Lady Raman were at home to the delegates and this concluded a very successful Easter Congress.

A special meeting was also convened during the session to discuss the question of the All-India Academy of Science.

* * *

Madras Branch of the Indian Chemical Society.—The annual meeting was held on the 31st March under the Presidency of Dr. Gilbert J. Fowler. Rao Bahadur B. Viswanath was elected President and Dr. B. Sanjiva Rao, Vice-President. Dr. M. K. Aswathnarain Rao was elected Honorary Secretary.

* * *

Dye Research in Bombay University.—The laboratories of the newly started Department of Chemical Technology are now being equipped for studying the chemistry of dyes, and their optical and physical properties. The work that will be undertaken in the Department will have a special bearing on the problems of the Bombay Textile Industry. The equipment will also include a semi-works scale bleaching plant, a calico printing room and a dye house. On the Chemical Engineering side it is proposed to install small-scale chemical manufacturing plant of various types.

* * *

Appointments in the Bombay University.—We understand that the Senate of the Bombay University has resolved to make the following appointments in the newly established Department of Technology. Reader in Dyeing and Printing, Reader in Chemical Engineering, Lecturer in Experimental Dyeing, Lecturer in Industrial and Tinctorial Chemistry and Lecturer in Fuel Technology. The Senate have also decided to institute Diploma Courses in Soap Making, Paints and Varnishes, Dyeing, Printing and Finishing, Leather Tanning and Printing and Lithography. (*Chemical Age*, Feb. 24, 1934.)

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An Electrical Apparatus serving the three-fold purpose of measuring Hydrogen-ion concentration, detecting the degree of corrosion on metallic surfaces and carrying out potentiometric titrations, is described in the *Chemiker Zeitung*, March 7.

* * *

T. A. Kramossilsky-Maximiov has observed that the introduction of animal harmones such as Insulin, Prolan and Ovarin into the endosperm of the germinating seeds of oats, induces an enhanced vegetative growth in plants, with a corresponding retardation of the reproductive phase (*Bull. Appl. Bot. Gen. Plant Breeding*, III Series, No. 3, 161, 1933).

* * *

Paper from Flowering Bamboos.—Mr. C. G. Trevor, C.I.E., I.F.S., Inspector-General of Forests, Dehra Dun, writes that while the experiments on flowered and unflowered bamboos (*Dendrocalamus strictus*) carried out by Mr. M. P. Bhargava, Officer-in-Charge, Paper Pulp Section, Dehra Dun, at the request of the Government of H. E. H. the Nizam of Hyderabad (and not by Mr. Khaja Nizamuddin as previously reported) show that flowered bamboo is suitable for paper manufacture, it is too early to make a general statement, until the results are confirmed by further experiments with bamboos from other areas and other species. Further, the fact that flowered bamboos can be utilised for paper manufacture is not the only or the most important factor in dispelling the fear regarding the interruption of supplies of raw materials during the period when a bamboo forest flowers. Generally speaking, the gregarious flowering of a species of bamboos occurs like an epidemic wave beginning at one edge of an area and proceeding across it in 5 to 12 years' time. The period required for the establishment of the new crop from the seedling stage, coincides with the above period, so that, by the time the last patches in a given area flower, the new crop in those areas which flowered first is fully established. Thus the flowering of bamboos does not generally jeopardise the continuity of a supply of raw material. Should, however, the new crop prove insufficient for some time for the requirements of a mill, the flowered bamboos can be utilised to fill up the gap. The knowledge that flowered bamboos can be utilised for paper making, therefore, helps to make it certain that the flowering of bamboos is not likely to menace the continuity of supply of raw material to a mill.

* * *

The Reducing Action of Lignin.—Mr. P. B. Sarkar, Chemical Laboratory, Dacca University, writes :—

Lignins from various sources have, almost without exception, been found to reduce Fehling's solution. This has been attributed to a CHO-group and provision has been made for it in the constitutional formula of lignin proposed by different investigators from time to time. There is a di-oxy-methylene group as well in the lignin molecule, which, as a rule, suffers decomposition to a greater or less extent, depending on the method of isolation. The two phenolic (OH) groups in the ortho-position which thus result, have now been found responsible for the reducing action. It is thus possible to separate the jute-lignin (obtained by 42% HCl at 20° for 24 hours) into two fractions by repeated treatment with dilute NaOH at room temperature until the washings are colourless. The soluble fraction reduces Fehling's solution readily and liberates silver from ammoniacal solution of silver nitrate just like protocatechuic acid or pyrocatechol, while the insoluble one shows no reducing property at all.

The higher the temperature and the longer the time of exposure to the acid, the less has been found the percentage of formaldehyde in the separated lignin, and the greater the reducing action as well. It is therefore quite unnecessary to assume the presence of an aldehyde group to explain the reducing property of lignin.

* * *

Prizes for the Encouragement of Publication of Modern Works in Dravidian Languages.—According to a notification from the Registrar of the University of Madras, dated 6th April 1934, prizes of the value of not less than Rs. 750 each will be awarded by the Syndicate in January 1937, for the best works in any or all of the Dravidian Languages—Tamil, Telugu, Malayalam and Kanarese—on any of the following subjects :—

Electricity.	Hygiene and Public Health.
Plant Life.	Rural Reconstruction.
Motors and Motor Transport.	Physiology.

Competitors for the prizes should submit six copies of each of their works, so as to be received by the Registrar *not later than the 1st October 1936. Only complete works printed and published at least six clear months in advance of the date of award will be taken into consideration.* In awarding the prize, the printing and get-up of the works will also be taken into consideration. *Works by joint authors (say a scientist and a specialist in a language) will be accepted for the prizes.*

The prizes will be awarded ordinarily to persons who are natives or domiciled in the areas within the jurisdiction of the Madras University. Competitors should, therefore, forward with their works, evidence of their domicile.

The competitor should also certify that the work submitted by him has not previously formed the basis for the award of any prize or title.

The Syndicate may divide the prizes among works of equal merit or decline to award the prizes on the ground that none of the works submitted reaches the proper standard of merit.

* * *

We acknowledge with thanks the receipt of the following :—

"Nature," Vol. 133, Nos. 3354 to 3358.

"The Chemical Age," Vol. 30, Nos. 763 to 767.

"Canadian Journal of Research," Vol. 10, No. 1.

"The Journal of Chemical Physics," Vol. 2, Nos. 2 and 3.

"The Biochemical Journal," Vol. 27, No. 6.

"Berichte Der Deutschen Chemischen Gesselschaft," Vol. 67, Nos. 2 and 3.

"Journal of Agricultural Research," Vol. 47, No. 10.

"Experiment Station Record," Vol. 70, Nos. 1 and 2.

"American Journal of Botany," Vol. 21, Nos. 2 and 3.

"Journal de Chemie Physique," Tome 30, No. 10 and Tome 30, No. 1.
"The Review of Scientific Instruments," Vol. 5, No. 2.
"The Mathematics Student," Vol. 1, No. 4.
"Scientific Indian," Vol. 11, No. 62.
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"Medico-surgical Suggestions," Vol. 3, No. 2.
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"Indian Journal of Physics," Vol. 8, No. 3.
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Reviews.

Elementary Chemical Theory and Problems. By N. M. Shah. (Published by the Karnataka Printing Works, Dharwar. Pages 145.) Price Re. 1.

The author claims that a special feature of the book is that every chapter is introduced with a clear and complete account of the main principles involved in its subject-matter. But the explanation of the theoretical principles seems to lack in rigour and thoroughness. Considering that the book is meant to satisfy the advanced needs of the I.Sc. students, the details regarding estimations of elements in organic compounds seem to be superfluous. A number of examples have, however, been completely worked out in each chapter and the various steps are well explained. Further a large number of exercises have been given at the end of every chapter. The get-up of the book is not as good as is desirable.

M. Seshaiyengar.

* * *

Sex and Sex Ethics. By Rene Guyon. Translated from the French by J. C. and Ingeborg Flugel with an Introduction by Norman Haire. (The International Library of Psychology and Sexology. John Lane, The Bodley Head Limited, London, 1933.) Price 15*s*. net.

The sale of this book is limited to certain professions and research students. We do not know whether official censorship has imposed this restriction. We can, however, discover nothing in the book which may be presumed to offend the public sentiment of decency and morals; rather a perusal of it is, in our judgment, calculated to elevate and strengthen them.

Undoubtedly the book is a notable contribution to sexological literature, absolutely pure and scientific in the exposition of the several aspects of the sex problem, catholic and courageous in outlook and logically correct in conclusions regarding the various codes of sexual morality. The author is an advanced rationalist whose judgments are unfettered by the conventional shackles of religion which surround our sexual ethics. Few can brush aside the hard shell of prejudice and convention which are believed to secure the stability of society and can examine the sexual phenomena and morality in a strictly detached scientific spirit and subject the various forms of sexual self-expression popularly known as aberrant to philosophical or logical criticism. Conventional modes of thinking and social prejudices die hard and people brought up on the milk of religious traditions have no patience with any attempt, however necessary, to revise our old sexual conventions. Sexuality under the sanction of the duly appointed priests and with the official approval of parents, is recognised by law, praised by society and exalted by religion but its manifestation outside this formal limit or in any altered form is condemned by bell, book and candle.

Commencing with the study of sexuality from an historical and phylogenetic standpoint, the author arrives at certain conclusions regarding sexual responsibility, modesty and the justifiability of certain taboos concerning certain acts and bodily organs. It is extremely doubtful whether public opinion will approve of the author's views about chastity and its exaltation as a virtue by moralists, but his penetrating study

of the question is entitled to praise. According to him the usually accepted conception of normal and abnormal sex life is really based on a want of proper appreciation of the natural modes of its expression in infancy. It is true that from a physiological standpoint, the pleasurable sensation due to excitement is subordinate to the more fundamental function of procreation, but it is for procuring the former that lives are sacrificed. The author takes what might appear an ultra radical, but really the only possible view of the theory of psychoanalysis, *viz.*, the sexual ethics which is faulty must be revised rather than the patient should be taught to adapt himself to an irrational system. He examines certain "extraordinary" practices such as onanism, incest, homosexuality and comes to the conclusion that they are neither "abnormal" nor "sinful". The subject of "love" expounded in the penultimate chapter of the book is brilliantly analysed and the author preferring to call it "individual love" condemns its exaltation at the expense of other forms of sex manifestation.

Sex problem is hardly yet regarded as a vital public question and the prevailing opinion is that it is best left alone. There is an element of apprehension that the public discussion of what is avowedly looked upon as a delicate and private subject will stimulate endless curiosity and probably may lead the younger men and women into devious paths. Society as it is at present constituted is based on conventions and if the latter were to be upset, the whole structure of the former is likely to crumble. It seems to us that the proper attitude of the public to the sex problem should be to remove the unmerited foolish shame which surrounds it and treat it with no more delicacy than any scientific topic is dealt with. The progress of knowledge implies continuous revision of views generally accepted as inviolable and if old mouldered code of morality is to be replaced by a new dispensation, society should have sufficient resource to readjust itself to the new spirit and the teachings of science. The book delivers the new message, which is ultimately bound to be accepted as an article of scientific humanism.

The book is admirable. If the author needs courage to expound his doctrines, the reader requires more courage to read them. We do not anticipate that the book will be welcomed by the intellectually timid and the sacerdotal section of the people but that this new code of sexual ethics will eventually become the creed of reformed society of the future, few will doubt.

* * *

Man and Woman in Marriage. By C. B. S. Evans, M.D., F.A.M.A., with an Introduction by Rudolph W. Holmes, M.D., F.A.C.S., and a Preface by Norman Haire, Ch.M., M.B. (The International Library of Psychology and Sexology. John Lane, The Bodley Head Limited, London, 1933.) Price 5*s*. net.

Judging by the advertised articles, the requirements of modern civilised man (and woman also) are bewilderingly varied and numerous. In fact from the date of his or her birth, the needs of the individual for a "happy and fashionable life" are carefully thought out and sold at "moderate price". Misshapen parts of human body can be rendered handsome at a small cost, those that are deficiently formed or are lacking can be made full or are supplied for a trifling consideration. The skin is treated, the brain is trained, the limbs are made strong, the bath is medicated, the food is supplied in tins of vitamins, the hair converted into any desired colour and curls, the nose may be grown to the fashionable size and straightness and all the internal viscera and endoskeleton can be adjusted to carry out their proper physiological functions and as for toilet and articles of dress, one has to look into the advertisement pages of any popular magazine to be convinced that they are not so simple as might be imagined. The make up of a society woman is manifestly an elaborate and tedious affair and if cleverly carried out, will cover up any natural defect. Frequently it happens that a steady resort to artificial means of improving looks which do not require any adventitious aids, may result in worsening them and a continuous application of irritating or "soothening" chemical preparations instead of improving might produce undesirable effects in the long run. Perhaps the safest thing is to rest content with what nature has endowed us with and carry our face and features as God made them.

We are puzzled to be told that men and women require advice as regards the facts of their married life. This department of life, we had thought, was too intimate and natural to be made the subject of public discussion. It is true that it has now become most unfortunately necessary to educate the public on marriage or sex hygiene but this can be imparted to the young men either as

a course of instruction in science in the schools and colleges or as part of the University Extension Lectures or the information may be given through a series of illuminating articles in the newspapers. The conditions of modern life have introduced dire sex diseases whose spread and ravages must be combated by every means at our disposal. It is, however, surprising to be told that a large number of men and women are in need of instruction in the performance of the most natural and instinctive functions to the satisfaction of the parties concerned. Drugs which are alleged to improve and strengthen the exercise of these functions and books which purport to give advice on them must be popular at all times among the neurotically disposed persons.

We have read this book with considerable amusement. Obviously the modern educated man and woman need instruction and advice on matters which their less favoured brethren and sisters can manage without books and drugs. According to the testimony of the author, there are several thousands of persons whose married life can be rendered happy by timely and hourly advice and who without it are apt to lead a sexually starved existence. We have every reason to regard this statement as substantially true and in every such case, the advice given in the book will be found competent, wholesome and satisfactory. Perhaps over-education renders people over-nervous and the nervous energy primarily intended for procreative purposes, if prematurely expended in enriching the mind, must result in an impoverishment of the rest of the body.

The book gives excellent advice to people who require it. To write such a book may be an act of public service. But a greater and more enduring service to humanity would be to investigate and remove the causes which lead men and women to accept such advice. It seems to us that the false shame which surrounds the subject of sex and which is so productive of evils, must be one of those causes and if it were so, the remedy is obvious. Young men ought to receive as a part of their education instruction as regards the biological import of sex life, its intentions and implications from the sociological and philosophical standpoint, with due emphasis on its practical and hygienic aspects. Under the influence of modern excitement, young men are apt to forget that their sense of self-respect and their instincts of personal dignity demand conservation of nervous energy which like worldly treasure should be augmented rather than extravagantly expended. The road to its enrichment is a simple and God-fearing life. If you cannot walk on this path, then read and profit by Dr. Evans' book on *Man and Woman in Marriage*.

* * *

EIGHTEEN YEARS ON LAKE BANGWEULU. By J. E. Hughes with an Introduction by Major H. C. Maydon. (Published by the Field House, Bream's Buildings, E.C.4, London.)

The author says that "the writing of this book has been a tougher task than stopping a charging buffalo". This does not appear to be the experience of most modern writers and the general reader might be tempted at certain moments to wish that these authors also found at least occasionally that it was so with them. The book is an excellent contribution to our knowledge of the Geography of that portion of Africa between Belgian Congo and North-East Rhodesia and its interest is not confined to sportsmen alone. The picture of the country with its lakes, rivers, mountains, marshes, forests and wild game together with a description of the native inhabitants, their manners, customs, habits, dwellings, dress, food and social organisation and powers of educability, has an irresistible attraction and we confess that we have read the book with great pleasure and profit.

Geography teaching in the schools has no doubt undergone within recent times a considerable change, but still there is pathetic adherence to the practice of memorising details of produce of countries, lists of the names of towns and the pupils generally fail to develop a mental picture of the country as a whole. It is not uncommon to find among even highly cultivated people, instances of gross ignorance of simple, elementary geographical facts and few among the educationalists realise that the proper and efficient teaching of Geography entails a deep knowledge of cultural and physical Anthropology, Ethnography, Geomorphology, Climatology, Biology and the physical sciences. It may be true that we may not find at the present moment teachers possessing such an ideal equipment, but if the subject is to be taught in all its scientific bearings and human significance, then it is manifest that we have to take measures for providing our teachers of Geography with the necessary training in all the collateral

branches of knowledge. In certain provinces of India, Geography is a neglected field, being made an optional study in the high school curriculum. We are not quite sure whether this sort of educational reform is an indication of wisdom. It is impossible to follow a modern newspaper without an adequate knowledge of the World Geography and we do not sufficiently appreciate that the geographical facts lend themselves to be treated from the scientific and human standpoints and as an instrument of education, its power and influence are far superior to any of the subjects which form the core of compulsory studies.

The chief merit of the book is that its chapters provide independent topics for study and one may commence from any chapter and obtain a vivid picture of a portion of the extensive territory forming the subject-matter of the book. We have ourselves followed the usual practice of reading books and every page has an account either of a thrilling encounter with some one or other of the big game, or village life, river system, picnic party, crocodile hunt, seasons and climate, fauna and flora of the plains and mountains or the geological formation of the different areas. The observations recorded in the book have a great value to the scientist and the explorer and the notes given in the appendix provide equally interesting reading. We have here a good book, written in simple and elegant style, vividly portraying everything worth knowing about Central Africa and forming a valuable contribution to the Geographical literature. We are tempted to suggest that everyone wishing to have a closer acquaintance with this interesting continent and more especially teachers of Geography must possess a copy of this book.

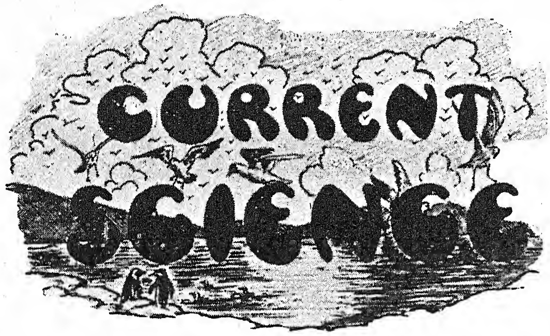
After reading the book, we cannot refrain from feeling that the destructive activities of the sportsman must eventually result in the upsetting of the balance of nature much to human detriment. The indiscriminate slaughter of animals having scientific and economic interest, must necessarily produce repercussions whose consequences we may not foresee at present, but undoubtedly are bound to be deep and far-reaching. Is it humane or necessary to go so far afield to kill animals and seek pleasure in their death agonies?

* * *

LES FONDEMENTS DE LA THEORIE DE LA RELATIVITE GENERALE; THEORIE UNITAIRE DE LA GRAVITATION ET DE L'ELECTRICITE; SUR LA STRUCTURE COSMOLOGIQUE DE L'ESPACE. Par Albert Einstein; Traduit de l'allemend par Maurice Solovine. (Paris: Hermann et Cie, 1933.) Prix 35 fr. broché.

The brochure is a collection of three papers by Einstein translated into French by Maurice Solovine. The first of these papers is the classical one of 1916 on the General Theory of Relativity. The second is the work of Einstein and Mayer containing the new unified theory of Electricity and Gravitation, based on the five dimensional theory of Kaluza and communicated to the Berlin Academy in 1931. The third is the translation of an article contributed in September 1932, giving a summary of the ideas that led to the theory of the Expanding Universe and showing that there is no reason to suppose that space is curved. The importance of these papers needs no new mention and the publishers must be congratulated on making them available to a larger public. The elegance and clarity of the French language have made every one acquainted with it wish for and welcome a translation into it of any abstruse disquisition. We are sure that the translation will find a large circle of grateful readers, who will also be delighted to find a good portrait of Prof. Einstein at the beginning of the book.

586-34. Printed at The Bangalore Press, Bangalore City, by T. Subramania Aiyar, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., for the "Current Science" Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore.



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Lord Dawson's Bill.

THE debate on the motion of Lord Dawson for the second reading of the Bill, which he moved on the 13th February, to restrict the sale, display and advertisement of contraceptives, produced in the House of Lords quite a number of interesting speeches, which together with a critical examination of them by Dr. Marie Stopes, are published in the March number of *The Birth Control News*. The Bill passed the second reading by a large majority and was referred to a Committee of the Whole House.

It may be remembered that the law in relation to birth control varies widely in the Western countries. In Great Britain contraception is legalised, due probably to the realisation of the widespread practice of methods for spacing births or avoiding children and also to the recognition of the change in public opinion and withdrawal of opposition by the Church and the medical profession. In 1930 the Ministry of Health in its Memorandum 153 M. C. W. authorised local Public Health Authorities and private agencies to establish clinics for the dissemination of free Birth Control information to married women; in Russia and Mexico, the governments are actively interested in the propagation of contraceptive methods among all married people. Since 1920 France, alarmed at the shrinkage in her population, has set her face against birth control literature; Ireland and America have banned all practical information concerning contraception. Many of the smaller European states and also Australia and Canada prohibit the sale of contraceptive literature and apparatus; but in South Africa, Germany, India, China and Japan there are already birth control clinics and advisory centres.

In his otherwise lucid exposition of the doctrine of birth control, Lord Dawson of Penn has made some remarks which may be used against the very cause he so warmly espouses. The *ex cathedra* observation that "birth control is here to stay and is part and parcel of social fabric" is not likely to be accepted wholeheartedly by the Anglican Church in spite of the famous resolutions passed at the 1930 Lambeth Conference of Bishops, and is relentlessly opposed by the Roman Catholic Divines. It is true that every speaker in the House of Lords has testified to the fact that there is a rapid

spread of contraceptive practice in the country with its attendant evils; but all the same there must be a very large section of the community who still prefer to restrict the size of the family by exercising prudence and abstinence in conformity with the dictates of moral and religious conscience. If, however, present-day youth in the mass have decided on limitation of pregnancy and its determination by choice, we are disposed to think that their resolution cannot all be the outcome of the conviction that economic grounds and family reasons constitute the foundation of their families. On the other hand, the Lords Spiritual have depicted a dreadful picture of the abuses of contraceptives and the total effect of their speeches must be disquieting to all who have faith in the moral foundation of society and the authority of the Church. The object of the Bill is to protect and defend the young people from being prematurely introduced to contraceptive knowledge, for nothing can be more disturbing to the welfare of the society than sexual precocity in youth. If the blatant advertisement of birth control devices and the erection of automatic machines in the open thoroughfare could be prevented by legislature, the author of the Bill hopes that the innocence of youth will be sufficiently safeguarded. Any careful observer must have noticed that these are not the only baneful influences to which the young people are exposed, whose morals are often also corrupted by obtrusive advertisements of aphrodisiacs and abortifacients, unworthy films and sensational catch-penny novels. The Bill strives to remove only a couple of factors from an extensive environment whose influence in precociously exciting the morbid curiosity of children is as subtle as it is dangerous. The educational and domestic authority for fortifying the mind of youth in the principles of morality is frustrated by what youth sees and hears everywhere; and exposure of contraceptives to public gaze is not more damaging to the interests of public morality than are the other hostile influences.

If under the particular circumstances of this age, a married couple were by mutual consent to resort to birth control methods,—a course of action approved by Lord Dawson—it is maintained that the Church and society should not interfere with the personal predilections of people in a matter of such vital necessity for the health and happiness of the family and the improvement of children. There is hardly any happening even in the best ordered homes of people, the knowledge of which can be kept sufficiently confidential for a long time and the greater the secrecy with which anything is guarded, the more irresistible is the curiosity of youth to explore, investigate and discover everything about the matter in its own time and in its own way. Once the knowledge of the existence of contraceptive goods is gained by children, they will most naturally proceed to try them: and all knowledge is communicable. The diffusion of such knowledge gained first hand in the very premises of their home must tend to destroy the innocence and value of childhood which the bill purports to protect. Moreover, as the Bishop of St. Albans has pointed out, if for economic and social reasons married people are to be permitted to impose limitation on the size of their family, there must be a still larger number of men and women who on economic grounds cannot at all marry. The problem of such people is at once delicate and difficult. Lord Dawson has given it as his solemn medical opinion,—though many will disagree,—that abstention is impossible and hurtful to health and that it must eventually lead to irregularities and perversions which may be criminal offences. If this is so the case of people who remain single after the marriageable age has been left behind, must constitute a serious problem fraught with sinister consequences to the welfare of the individuals concerned and the society to which they belong. If self-control, however valuable as a stabilizing element of human character, is deleterious to health, and the medical profession has provided the people with the means of avoiding responsibility for the biological consequences of their actions, unmarried people will have a strong incentive to resort to birth control methods. If the purpose of contraceptive philosophy is to exalt the gratification of the fundamental appetite on easy terms and without regard to the primary obligations with which Nature has invested it, will not marriage as a voluntary human institution for the propagation of the race tend gradually to become obsolete, with the possibility that the government may have to take it over as a branch of civil administration?

Almost all advocates of birth control start on the assumption that women have a natural aversion to child bearing, and even in cases where no pathological conditions are indicated, they point out that frequent pregnancy

must inevitably undermine the physical health and domestic happiness of the individual. Lord Dawson in describing the large families of the early forties of last century, such as the Gladstones and the Lyttletons, makes no reference to the injurious effects which a numerous family is reported to produce. It seems to us that if a mother suffers after moderate child bearing, ordinarily it must be due to want of sufficient food, clothing, accommodation and medical advice; and provided that all these things are procurable by every person in a requisite measure, so as to preserve his and her health on a reasonably high standard, can it be proved that moderate child bearing in such circumstances, produces the grave consequences which the birth control methods seek to prevent? According to Lord Ponsonby, what the majority of people require is suitable work, adequate wages, a cheap and sufficient supply of wholesome food and clothing, decent housing accommodation and free medical advice. It is one of the strange ironies of the present age that decent men and women are unable to obtain the reasonable comforts of life which their capacity to serve the body politic ought to procure. Lord Ponsonby further pointed out that when he was Under-Secretary at the Ministry of Transport, he was able to gather figures which showed that among the income-tax paying classes there was a greater increase in the purchase of cars than in the production of babies,—a fact which proves the growing tendency on the part of the professional classes and the rich to evade the responsibilities of tending and educating children and to spend all the available time and money in procuring personal enjoyments. It is doubtful whether birth control methods lend themselves to be used as correctives of the evils produced by a faulty social and economic system.

To our mind birth control methods only touch the fringe of the population problem, though their advocates claim that they produce happier homes, healthier motherhood and a better race of children endowed with a finer character. Lord Dawson has pointed out that this social ideal has permeated the skilled and semi-skilled working classes who have adopted the contraceptive practices so that a decline in the birth rate of 14·4 per cent. has occurred in Great Britain in the ten years between 1923 and 1933. The so-called "circumstances of the age" seem to be only synonymous with unequal distribution of wealth, unemployment consequent on mass production and defective mechanism of marketing the produce and slums produced by factory labour. Are these disfigurements to be permitted to extinguish the nobler and heroic virtues which distinguished the older generation of men and women who, with fortitude, resource and self-sacrifice, reared a large number of children amid the picturesqueness of family love, loyalty, devotion and discipline? Perhaps a readjustment of the existing social system may secure for the people better homes, more money and greater means of enjoying the amenities of life than the practice of birth control methods can hope to place at their disposal. Is there not enough room in the British Empire for establishing and developing more colonies where the excess population can be properly placed to bring up their numerous children as self-respecting citizens without exposing them to the evils of the widespread use of contraceptives which is reported by the Lords Spiritual to be common among unmarried persons?

The prevalence of these evils is admitted by Lord Dawson and their increase is attributed to extravagant displays of contraceptives, the construction of automatic machines and shameful appeals to the young and old alike to purchase, and profit by, chemical preparations. The evils bitterly alluded to by the Lords Spiritual is traceable in no small measure to the attitude of the Church and society towards fallen women and their illegitimate offspring. To repress is to excite curiosity; to forbid is to stimulate action; this law of contraries is an essential ingredient of the human mind. Religion and society by steeping sex in shame ran it underground, and will both produce a constructive and feasible scheme for overcoming the biological consequences of fornication without absolute continence. Our attitude to the sex problem must change and the Church must develop a finer code of morality more practicable and convincing than the old one, which is no longer adequate and thus fails to check the evils of illicit intimacy. For the danger of these evils is intensified by the sophisticated food of civilised man, precociously stimulating the fundamental instincts, and by the fact that these instincts are fostered by the greater freedom of action now enjoyed by the members of both sexes and by the deeper and subtler influences of environment.

A more significant population problem than the quantity of mankind, is the quality of individual members. In order that a nation may become prosperous, happy, efficient and peace-loving, a sound contribution to general intelligence and moral stability has to be made by all the grades and classes of society. The mere limitation of the family which may perhaps secure for the children a better average of education and a more decent start in life, does not ensure that all the children born under the contraceptive auspices will possess the best qualities. It is doubtful whether even the creation of a Ministry of Marriages, such as Charles Whibley cynically suggests, assisted by a Secretariat of bright-eyed young Mendelians, could, by selective breeding, produce and fix the desirable type of individuals, for "men and women are not peas" and they must have their own personal inclinations which are beyond the range of experimental marriages. Heredity is a supremely fruitful field but its mechanism still baffles human ingenuity. The very essence of strength and beauty of humankind is individuality, which is divergence and the ambition to fix the type, even were it possible, must be undesirable. Neither birth control methods nor all the tender faith in the efficacy of legislature will suffice to improve mankind; we shall have to rely on education, public opinion and the precepts of religion for its betterment, however true it may be, that the son profits little by the intellectual and moral acquisitions of the father and has to begin it all over again from the very commencement.

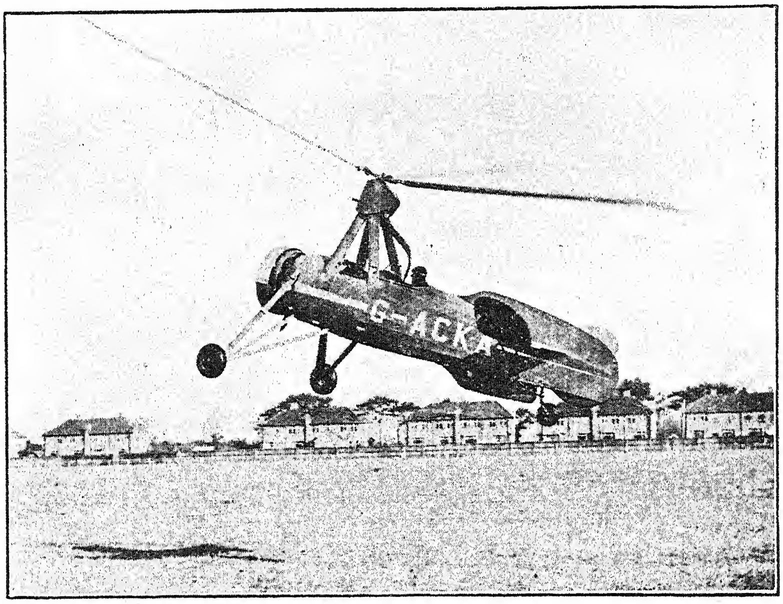
If we really want our people to flourish then we should give every one an equal chance to succeed in life: and, knowing that the people who, possessing the highest inborn intelligence and moral energy, are the ones who are actually contributing most to the welfare of the community, we have to encourage them to have as many children as they healthily can in the hope that being born of a good stock in a good environment, they may repeat or improve on the worthiness of their parents. It may perhaps be necessary to discourage the people who are decidedly inferior to have numerous children. The indiscriminate and extensive employment of contraceptive technique by the professional and richer classes alone and the inability of the less favoured community to procure birth control advice and appliances must produce results whose consequences to the nation will be obviously unsatisfactory. If any bill on the subject of birth control is needed, legislative sanction should be obtained to prohibit the sale of contraceptives to the well-to-do classes and to place the appliances within the easy reach of others whose contributions to the prosperity of the people must in the nature of things be somewhat lower. Many of the social abuses now attending the propaganda of birth control knowledge and free sale of contraceptives, which the Lords Spirituals have painted in lurid colours, may be removed by restricting their purchase at specified hours during day time in a few licensed shops and on the production of a certificate from a competent medical authority that the purchaser is married and that the goods are intended exclusively for his personal use. The birth control movement is in the nature of a physiological and psychological experiment, regarding the results of which there is not a unanimous and authoritative body of opinion; and it is neither safe nor wise to permit it to gamble with life without sufficient safeguards. Nevertheless the question of birth control and the law of abortion must, as pointed out by Justice McCardie, be investigated free from prejudice whether theological or otherwise; and if the problems were to be treated like other scientific problems, perhaps their implications might lose many of their horrors.

The "Direct Control" Autogiro.

By Colonel John Josselyn, C.M.G., D.S.O., O.B.E., T.D.

IT is safe to assume that most people nowadays are familiar with the Autogiro either from actually having seen one on the ground or in flight or from pictures, literature, or hearsay. It will therefore be enough to say that the Autogiro is an aircraft which obtains its lift entirely from a system of rotating blades, called the rotor blades, mounted on a pylon structure attached to the fuselage in place of the usual centre section of the ordinary fixed wing æroplane. These blades are hinged at the root allowing freedom of movement up and down as the rotor revolves. Once in the air no engine power of any kind is required to keep the rotor system revolving, its rotation being entirely due to ærodynamical action.

If one considers the action of the blades in flight, it is found that, due to the centrifugal force and the lift acting simultaneously, the blade will assume an angle to the normal. Now if the path of the tip of the blade is traced it will be seen to rise and fall, the rise taking place during the period in which the blade is advancing, and the fall during the period of retreating. When the blade is advancing the speed with which it travels with respect to the opposing wind is increased by the forward speed of the aircraft. If the blade were not hinged then the lift on the advancing blade would be considerably greater than that on the retreating blade, but the hinge allows the blade to rise, decreasing its incidence and thereby its lift. On the other hand, the fall of the retreating blade increases its lift with the result that the lift on the blades is equalised and the resultant lift of the whole rotor is fixed at or very close to the centre of rotation of the blades.



Considering then the action of the disc formed by the revolving rotor blades, we find that, again owing to the forward speed, the tip of the blade at the front of the machine is higher than that of the rear blade, so that the plane of the disc is inclined backwards and slightly down on the side of the advancing blade. The direction of the lift force will be normal to this plane. Lateral and directional stability is maintained by small fixed horizontal oblique and vertical fin surfaces at the tail of the fuselage.

One of the difficulties under which the Autogiro has to some extent suffered during the years of experiment in perfecting the rotor system has been the question of the degree of control at the slow speeds at which the machine is capable of being flown

with perfect safety and freedom from any possibility of stalling, and in vertical descent when there is no forward speed at all.

The basic problems of flight are three: Lift, Stability and Control. The Lift of an Autogiro and its safety and stability are fundamentally independent of its horizontal speed through the air, unlike the ordinary fixed wing æroplane which is entirely dependent for its lift and stability and consequent safety on the maintenance of a high forward speed through the air. On the other hand, the degree of control obtained by means of ailerons, elevators and rudder as in the fixed wing æroplane is dependent on the speed at which these control surfaces are forced through the air. Consequently in the lowest forward speeds, or in vertical descent, such as are possible with the Autogiro from the point of view of lift and stability the ordinary fixed wing æroplane controls were sluggish and almost ineffective. In order to overcome this difficulty Mr. de la Cierva, the inventor of the Autogiro, and the person who has been responsible for its development throughout, contrived what is called the "direct control" arrangement, whereby control is no longer dependent on small moving surfaces attached to fixed planes but is transferred to the rotating disc which is the whole supporting surface of the machine.

This type has therefore no fixed wings or control surfaces such as ailerons, elevators or rudder, the only fixed surfaces being fixed horizontal, vertical and oblique fins at the tail of the fuselage to give the machine directional and lateral stability and to counteract the effect of propeller torque.

In considering the action of the rotor blades in flight we have found as follows:—

1. That the lift force is roughly constant for a given attitude of machine.
2. That it acts at the centre of rotation of the blades.
3. That its direction is normal to the plane of the rotor disc.

As has been indicated above, the control of ordinary aircraft is achieved by altering the load on any of its control surfaces by changing the attitude of the surface with respect to the wind. In the new type of Autogiro the alternative of changing the direction of a force is employed. As the lift force acts normally to the plane of the disc of the rotor, if the attitude of this disc is changed by tilting the rotor then the direction of the lift force will be changed also.

To show how this works on a machine in flight see Fig. 1.

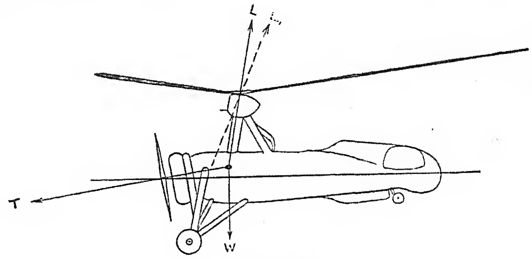


Fig. 1.

The thrust (T), weight (W), and lift (L), are shown acting at the C. G. of the machine and in equilibrium, for simplicity the tail load is neglected. This condition would give no tail load.

It will be clearly seen that if the direction of the lift force (L) is changed to that shown by the dotted line, this force will have a moment tending to raise the nose of the machine. In the same way if the rotor is tilted forwards in the opposite direction to that shown by the dotted line, it will raise the tail of the machine. Exactly the same results are obtained laterally if the rotor is tilted sideways and any combination of these fore and aft and lateral movements will produce corresponding movements in the machine.

So much for the fore and aft and lateral controls, but this "direct control" machine dispenses also with a rudder and some explanation of how it is turned without a rudder is necessary for a complete understanding of this novel aircraft. It is a well-known fact that a machine put into a bank without rudder will side-slip. Immediately this side-slipping commences it is equivalent to a change of direction of wind which will now press against the side towards which the machine is slipping, with the result that, exactly as a weathercock changes direction with a side wind, so an Autogiro with its large tail surfaces will change direction also. It will be seen then that to bank is automatically to turn. The lateral control on this type of machine might be referred to as the turning control.

Before going on to a description of the machine itself, it may be as well to explain how the propeller torque is counteracted in a machine of this type. In ordinary aircraft it is usual to counteract propeller torque by a differential setting of the ailerons. As there are no ailerons on the

'direct control" Autogiro, it is necessary to have this change of setting incorporated in the horizontal fin. A number of experiments were carried out to determine exactly what this setting should be, and it was found that if a certain ærofoil was given to the horizontal fin and reversed on one side, the propeller torque would be corrected.

Fig. 2 is a diagrammatic sketch of the hub and controls. It should be explained that actually the axle is not connected to the lateral hinge housing directly as shown in the sketch, but is mounted in ball bearings in the hub, the bottom cover of which forms the hinge housing.

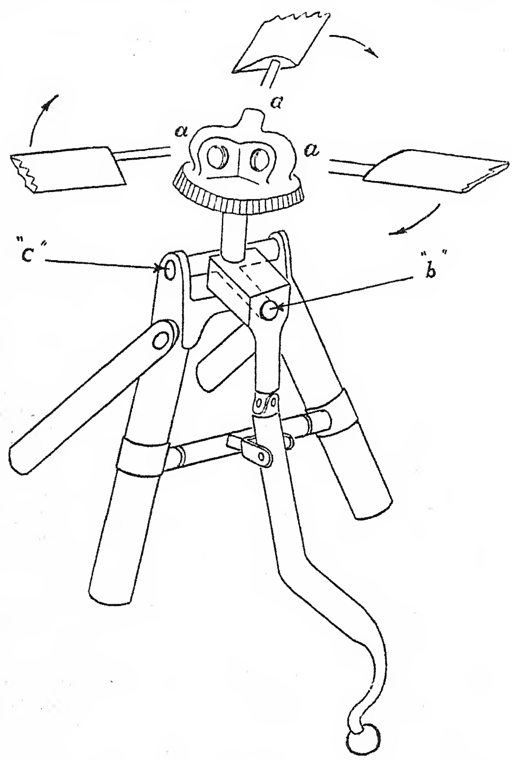


Fig. 2.

It is essential in a control of this type that friction should be eliminated as far as possible, and with this end in view, needle roller bearings are used at all hinge points.

The three blades are attached at the hinges marked "*a*" and the whole of the rotor system is free to turn about the hinges "*b*" and "*c*". These hinges are offset from the centre of rotation and the reason for such offset lies in the inclination of the lift force which has been explained above. The offset is such that the line of lift never passes through the hinges but slightly behind the longitudinal hinge and to starboard of the lateral hinge. When it is explained that for full control of the machine no more than 4° or 5° longitudinal tilt and 2° lateral tilt is required, it will be appreciated that the load on the hand necessary to control the machine must be small and the control very sensitive.

As a matter of fact, the control was found to be so light and so sensitive that during test flights it was found necessary to introduce flexibility into the system to diminish the sensitivity and to give the control a bias in order that the pilot may have a "feel" to the control. This bias, which is given both laterally and in the direction of tilting the rotor backwards, is merely an extra load supplied by springs, the strength of which was found by experiment.

From the sketch it will be simple to follow the control and it will be seen that, though with a hanging stick instead of one with controls attached at the floor of the fuselage, the control movements are exactly similar to those of orthodox craft, that is stick back to climb and forward to dive. In addition, as previously explained, the left or right stick movement will give a left or right bank and turn of the machine.

A brief description of the machine C. 30 P. (as illustrated) is as follows:—

Engine.—Armstrong Siddeley "Genet Major" 7-cylinder, approximately 140 h.p.

Propeller.—Fairey Reed metal propeller.

Fuselage.—Steel type welded construction seating capacity for pilot and passenger in open cockpits.

Undercarriage.—Split axle type—axle oleo leg and radius rod attached to fuselage—travel of oleo leg about 8″. Dunlop intermediate pressure wheels fitted with Bendix brakes. The undercarriage is fitted well forward on the fuselage—more so than is customary, to enable the engine to be run up on the ground without the tail rising. It must be remembered that there are no elevators to use during this operation.

Vertical Fin.—Steel tube welded construction, disposed equally about the centre line of the fuselage.

Horizontal Fin.—Wooden construction. The horizontal fin is provided with oblique fins which give added stability in all directions, lateral, longitudinal and directional.

Petrol System.—Gravity tank of 25 gallons capacity being sufficient for 3½ hours' flight.

Oil System.—An oil tank is fitted containing about 3½ gallons of oil.

Rotor Blades.—Steel tubular spar internally tapered, with ribs for shaping a ply covering.

Rotor Starting.—The starting of the rotors is accomplished by engaging a clutch, the driving side of which is driven by the engine. A lever in the pilot's cockpit operates the driven side. The drive is through bevel gears and a dog clutch

which is provided to ensure that the rotors could never over-run the engine. If this ever happened the two halves of the dog clutch would ride over each other. When the requisite number of revolutions of the rotor are obtained the clutch is disengaged by a quick release, situated on the pilot's dashboard.

Ground Steering.—The tail wheel of the C. 30 is steerable and is operated by a foot steering bar in the cockpit.

Performance.—No actual performance figures are available at the present time but, based on experience of former Autogiros, the following performance should be obtained :—

Top Speed	..	120 m.p.h.
Minimum Flying Speed	..	15 m.p.h.
Cruising Speed	..	95 m.p.h.
Landing Speed	..	Nil.
Take off run	..	12 yds. in still air.
Landing run	..	Nil.
Range	..	$3\frac{1}{2}$ hours, approx. 350 miles.
Ceiling	..	17,000 feet.
Climb	..	900 ft. per min.

On the Mechanism of Indian Tornadoes.

By Dr. A. K. Das, D.Sc.,
Alipore Observatory, Calcutta.

IN an article which appeared in the *Current Science* of June, 1933, I made the suggestion that tornadoes with the characteristic cloud funnel which occasionally occur in Bengal during the nor'wester season might be due to the downward bending of one end of the cylindrical whirl with a horizontal axis which should sometimes come into existence as a result of the mechanism of nor'westers which I put forward in a fairly detailed investigation[1] published in the *Gerl. Beitr. z. Geophysik.* The mechanism suggested for Bengal tornadoes could not at that time be supported by definite observational data of any actual tornado because such data were not available for any tornado of Bengal or of any other part of India; but the mechanism was perfectly in line with A. Wegener's theory of European tornadoes and appeared to me to be a necessary extension of the mechanism of nor'westers that would explain more satisfactorily the close relationship between the nor'westers and the tornadoes than other suggestions which postulate the pre-existence of local upward convections due to the overheating of the ground and consequently of the air in contact with it. There is ample evidence in meteorological literature to shew that the true upward movement of air through the tornado funnel is to be regarded as a subsidiary phenomenon and in fact, in some tornadoes its very existence is doubtful. It is to be remarked that the fact that objects are lifted up from the ground by tornadoes does not necessarily prove the existence of vertical convections of air in the tornado funnel.

In a paper[2] which has just appeared in the *Scientific Notes of the India Meteorological Department*, Flt. Lieut. R. G. Veryard has studied a tornado which occurred at Peshawar on the 5th April, 1933. This investigation is of great interest from the standpoint of Indian meteorology because it is the first paper which gives concrete scientific observations on the subject of tornadoes in India. Since Mr. Veryard intends to make in future a fuller study of this tornado I do not wish to utilise the data published by him in any other way than to indicate some of the features which appear to me to support the hypothesis put forward in my article in *Current Science* referred to above. The seven remarkably good photographs (showing the different stages of development of the tornado) which accompany Mr. Veryard's paper are extremely instructive from the point of view of the above hypothesis. On the first three photographs which represent the growth of the tornado the axis of the cloud funnel shows a gradual tendency to become vertical till on the fourth photograph which shows the fully developed stage the lower end of the funnel is almost vertical. On the three photographs showing the later stages one can see that the tornado is weakening and the axis of the funnel is steadily tending to become horizontal. Furthermore all the photographs show that at every stage the top of the funnel is sharply bent towards the cumulo-nimbus cloud and is joined up with it. It would, therefore, be natural to conclude that the original "mother whirl" with horizontal axis was inside the mass of cumulo-nimbus cloud and

[1] A. K. Das, "On the Mechanism of Thundersqualls in Bengal,"—*Gerl. Beitr. z. Geoph.*, Bd. **39**, 1933, pp. 144-166.

[2] R. G. Veryard, "A Preliminary Study of a Tornado at Peshawar,"—*Sc. Notes Ind. Met. Dept.*, **5**, 56.

that in the initial stages one of its ends became elongated and gradually tended to be vertical (growth of the tornado) and later it gradually bent back to horizontal and shortened (decay of the tornado) until it disappeared finally inside the cloud.

The tornado moved approximately from S.W. to N.E. and Mr. Veryard says in his paper, as he also informed me on my enquiring about it before his paper was published, that looking from south-west to north-east the tornado funnel which had an anticlockwise rotation was situated on the right-hand side of the main cumulo-nimbus tower and the rain and hail fell mostly on the left-hand side of the track. This is a very interesting and important observation from the point of view of the hypothesis of the whirl with horizontal axis. That the tornado funnel was situated on the right of the main cumulo-nimbus cloud looking in the direction of translation of the tornado is quite evident from the photographs if we take account of the fact that they were taken while the tornado was approaching the camera. On all the seven photographs the top of the funnel is bent towards the cumulo-nimbus cloud, *i.e.*, towards the right (as seen on the photographs) and it is on this side that there are indications though faint, of falling rain on some of the photographs. All these observations are strongly in favour of the hypothesis of the whirl with horizontal axis, and although from the study of only one case it is not justified to conclude with certainty about the correctness of the hypothesis in the case of Indian tornadoes in general, there is good reason to believe that the hypothesis is a very probable one; it would, of course, be necessary to have more detailed observations in order to subject it to a strict test.

Another very interesting point in Mr. Veryard's paper is the observation that the tornado funnel in question had two parts: an inner core and an outer mantle. It may be remarked that similar observations have also been made in European tornadoes particularly by Wegener and Letzmann, so that the similarity of the Peshawar tornado with those of Europe would appear to be very close indeed. It also appears to me that on the photograph showing the tornado at the fully developed stage one can even recognise three distinct zones; this would probably suggest the presence of a central core, an outer mantle and an intermediate zone as proposed by Letzmann[3] from theoretical considerations. If the velocity of the wind and the lowering of pressure in the tornado were available one might subject this tornado to a quantitative test to some extent.

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[3] J. Letzmann, "Über die Einflüsse positiver und negativer Beschleunigung auf ortsfest rotierende Flussigkeitssäulen,"—*Gerl. Beitr. z. Geoph*, 1930.

Focal Region of the North Bihar Earthquake of January 15, 1934.

By Dr. S. C. Roy, M.Sc. (Cal.), D.Sc. (Lond.).

IN his note* on the North Bihar Earthquake of January 15, 1934, Dr. S. K. Banerji has quoted the following epicentral distances of the earthquake estimated from seismic records:—Bombay 950 miles, Kodaikanal 1,400 miles, Agra 450 miles, Dehra Dun 100 miles, Mangalore 1,250 miles and Kew 4,600 miles. In addition to the foregoing distances one should also take into account the epicentral distance of 70 miles estimated by Calcutta. As pointed out by Dr. Banerji, these distances do not fix up any definite epicentre, but it would be premature to express an opinion regarding the extent of the focal region without a thorough scrutiny of the seismograms of all Indian Stations. It is undoubtedly true that the origin of an earthquake cannot be traced to a point-source but it is probably equally certain that the focal region from which the seismic waves of the principal shock of January 15 originated could not have been as wide as is suggested by the epicentral distances originally reported by the Indian seismic stations. Discarding the incredibly low values of 100 and 70 miles reported by Dehra Dun and Calcutta respectively, the original estimates of the epicentral distances made by other Indian stations are, however, reconcilable to a focal region of reasonable extent when it is remembered that the seismic tables used for the estimation of the epicentral distances are different at different stations. The Dehra Dun seismograms are not available for

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* *Curr. Sci.*, 2, 326, 1934.

scrutiny but a preliminary examination of the Calcutta seismogram (Fig. 1) along with the seismograms of Agra (Fig. 2), Bombay (Figs. 3 and 4) and Kodaikanal (Fig. 5) suggests that the original estimates by Calcutta

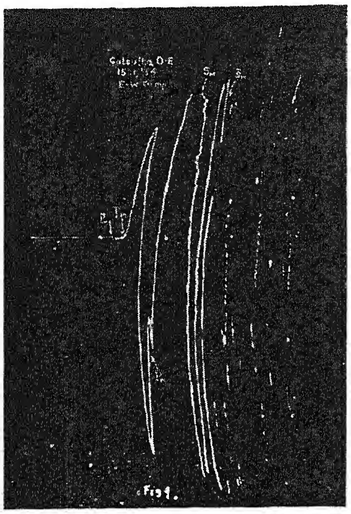

Fig. 1.

and Dehra Dun were based on some wrong identification of phases on their seismograms. In the absence of the Dehra Dun seismograms it is difficult to imagine the exact nature of identification of phases which led to the low value of epicentral distance reported by that station but the following suggestion may provide a possible reconciliation of the original estimates of Calcutta and Dehra Dun.

The nature of incidence of the first preliminary waves P_M on the Agra, Colaba and Kodaikanal seismograms (Figs. 2, 3, 4 and 5) is similar and appears to correspond to the point P_M marked on the Calcutta seismogram (Fig. 1). The very feeble movements which commenced at P_m on the Calcutta seismogram prior to the incidence of P_M and lasted for about 11 seconds, are doubtful on the Agra seismogram (Fig. 2) and are not at all traceable on the Bombay and Kodaikanal seismograms (Figs. 3, 4 and 5). An explanation that suggests itself is that the major failure which led to the principal shock was preceded by a minor failure by about 11 seconds and that Calcutta's original estimate of the epicentral distance was based on the supposition that the interval (P_M—P_m) represented the total duration of the preliminary and secondary waves of the principal shock. It is also not improbable that Dehra Dun adopted the same interval (P_M–P_m) as representative of the duration of the preliminary waves. In this connection it may be of interest to mention certain seismic phases characteristic of near earthquakes of shallow focal origin. A glance at the seismic data published annually by the Indian stations seems to show that the Indian seismology has not in the past recognised fully phases of the preliminary and the secondary waves other than the normal P and S. It is, however, well known that the preliminary and the secondary waves of shocks originating in the upper layer or crust of the earth can travel to a near station along three distinct paths. The normal primary waves P and the secondary waves S are refracted down into the ultra-basic layer where they travel with comparatively high velocities and are refracted up again to the observing stations. The longitudinal and the transverse waves can also travel directly from the focus to the observing station through the granitic layer (about 10 Km. thick) where they have comparatively low velocities. These direct waves are recognised internationally by the

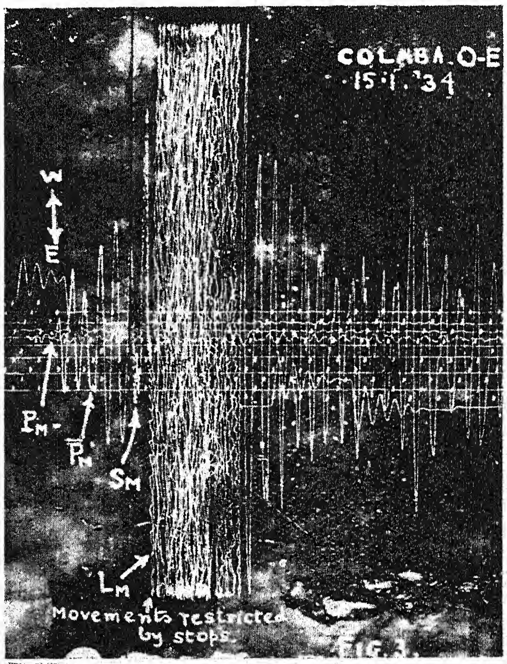

Fig. 3.

symbols $\bar{P}$ and $\bar{S}$. In addition to the two pairs of preliminary and secondary waves mentioned above there is a third pair P* and S* which travel from the focus to the

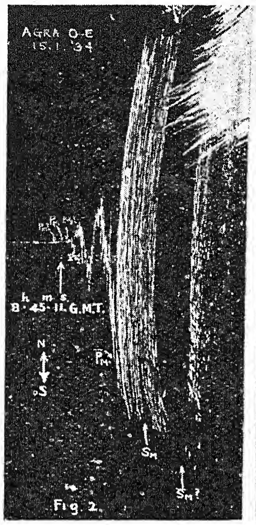

Fig. 2.

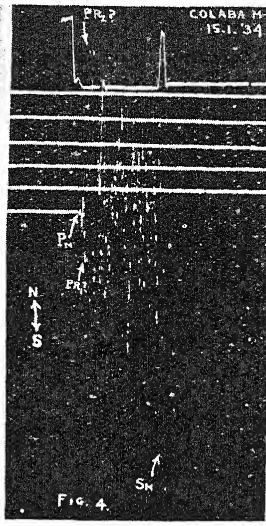

Fig. 4.

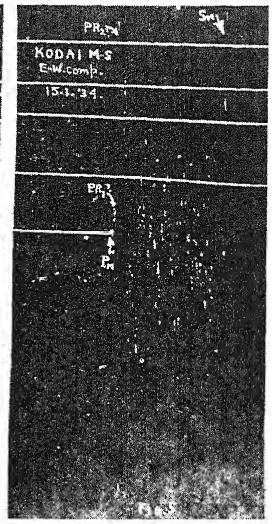

Fig. 5.

	Δ (Kms)	P_m	P_M	$\bar{P}_M$	S_M	$\bar{S}_M$	L_M	$P_M - O_M$
⊙ CALCUTA	493	$8^h 44^m 18^s$	$8^h 44^m 29^s$	$8^h 44^m 55^s$	$8^h 45^m 23^s$	$8^h 45^m 52^s$	—	$1^m 7^s$
X AGRA	805	45 00(?)	45 11	45 57	46 40	47 29	—	$1^m 49^s$
△ DEHRADUN	902	45 14	—	—	—	—	—	—
O BOMBAY	1610	—	46 48	48 20	49 38	—	$8^h 50^m 29^s$	$3^m 26^s$
✳ MANGALORE	1929	—	47 25	—	50 45	—	—	$4^m 3^s$
⊡ KODAIKANAL	2026	—	47 36	—	51 06	—	—	$4^m 14^s$

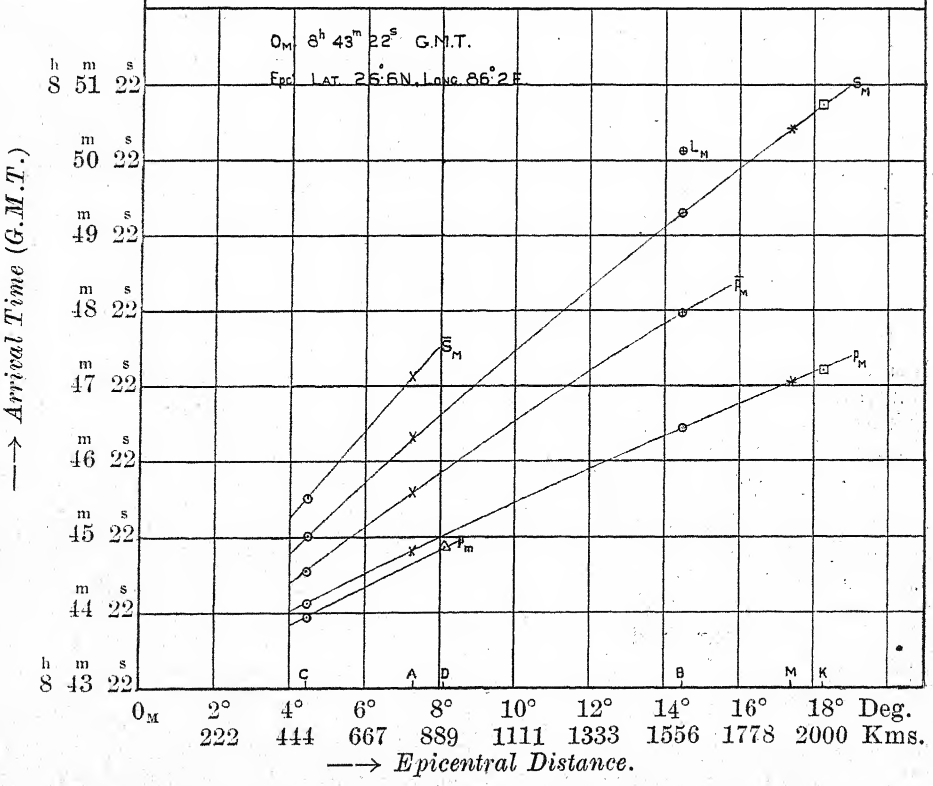

Fig. 6. Time-Distance Curves of North Bihar Earthquake of January 15, 1934.

observing station with intermediate velocities through the basaltic layer (about 20 Km. thick). The importance of the recognition of these six phases and also of the reflected primary and the secondary waves for a correct diagnosis of seismograms of near earthquakes cannot be over-emphasised. The phases P_M, $\bar{P}_M$, S_M and $\bar{S}_M$ appear to be identifiable on the seismograms of Calcutta and Agra (Figs. 1 and 2). The reflected waves are also traceable on some of the Indian seismograms (Figs. 2, 4 and 5) but the phases P_M^* and S_M^* are either absent or difficult to trace. One is naturally tempted to suggest that the phase P_m marked on the Calcutta seismogram may be taken as P_M and the phase marked P_M identified as P_M^* but the feeble nature of the movements of P_m and other characteristics of the Calcutta seismogram do not appear to support such an explanation.

The arrival-times of the important phases based on the present identification are tabulated at the top of Fig. 6. The origin time of the major shock as obtained by plotting $(S_M—P_M)$ interval against the arrival time P_M is 8 h. 43 m. 22 s. G.M.T. The epicentre is located near Lat. 26·6° N., Long. 86·2° E. in agreement with the following epicentral distances:—Calcutta 493 Kms., Agra 805 Kms., Dehra Dun 902 Kms., Bombay 1,610 Kms., Mangalore 1,929 Kms., and Kodaikanal 2,026 Kms. The time-distance curves of the important phases of the principal shock are also given in Fig. 6. The development of surface waves (Fig. 3) and the general trend of the time-distance curves of the various phases suggest that the focal region of the principal shock was of shallow depth, but a reliable estimate of the actual depth from the seismograms is not possible in the absence of records close to the epicentre.

The main object of the present note is to point out that a preliminary examination of the available Indian seismograms does not suggest that the focal region of the principal shock of January 15 was very abnormal in extent. A detailed discussion of the seismograms of the principal shock and its after-shocks will be published elsewhere.

Some Foreign Weeds and their Distribution in India and Burma.

By K. Biswas,
Royal Botanic Garden, Calcutta.

MR. A. C. JOSHI'S note on the occurrence of *Croton sparsiflorus* in the United Provinces, published in *Current Science*, **2**, 344, 1934,[6] prompts me to put down my observations regarding the distribution of some of the common harmful exotic weeds established in this country.

The interesting study of migration of foreign plants dates from a very early period, as far back as 1786, the date of the foundation of the Royal Botanic Garden, Calcutta (the then Hon. East India Company's Botanical Garden, Calcutta) and the Serampur Botanical Garden—generally known as Dr. Carey's Garden. During this time Roxburgh, "the father of Indian Botany", and Dr. Carey of great fame started cultivating in their gardens at Sibpur and Serampur, various species of foreign and indigenous plants with a view to have a suitable botanical garden of scientific value near Calcutta. This work was followed by such eminent botanists as Voigt, Wallich, Griffith, Buchanan, Hamilton, Falconer, Thomson, Anderson, Clarke, King, Gamble and Prain. Thus by the time Brühl published his *Recent Plant Immigrants* in 1908,[3] the Botanic Garden at Sibpur during the course of one hundred and twenty-two years, formed a centre of distribution of a large percentage of plants at present found in the neighbourhood of Calcutta in the district of Hooghi-Howrah and the 24 Parganas. Coastal invasion of foreign plants either by sea or by ships calling at the various ports of this country may be considered another source of migration of foreign plants. Exchange relation in plants with different gardens and introduction of seeds by private individuals may be other important factors of local migration of plants. The problem of distribution and dispersal of plants is too large to be discussed here. I refer the reader to the book entitled *The Dispersal of Plants throughout the World* by H. N. Ridley, 1930,[10] for sufficient information on this subject. The authors of the local floras such as Prain, Cooke, Gamble, Brandis, Duthie,

Haines and others have mentioned in their works some of the plant intruders of this country. Kashyap has recorded some of the foreign plants in his article on "Notes on some foreign plants which have recently established themselves about Lahore."[7] "In the list of species and genera of Indian Phanerogams not included in Sir J. D. Hooker's *Flora of British India*,"[5] Calder, Narayanaswami and Ramaswami have compiled in alphabetical order, the names of species published up to 1924 which were not noted in *Flora of British India*. This work covers 157 pages. Recent writers such as Brühl, Blatter, Parker, Kanjilal (Senior and Junior) Sabnis, Fyson, Parkinson, Mayuranathan, Tadulingam and the writer and others have also reported in their works some of the foreign plants. There has become, as the author experiences during his association with the herbarium of the Royal Botanic Garden, Calcutta, a large accumulation of foreign specimens. A comprehensive list of these 'Plant Immigrants' will be published in course of time.

Some of the most common foreign weeds chiefly hailing from tropical America have of late been almost terrestrial pest in different parts of the country. These weeds cover sometimes acres after acres of field or open places, and miles and miles along the railway lines forming more or less a pure association of their own. *Eupatorium odoratum* encroaches upon outskirts of the tropical evergreen forests in South Burma and penetrates into the Terai of the Eastern Himalayas sometimes struggling to replace the characteristic Savanah formation of this region. Some again spread rapidly in the plains and ascend with equal vigour to the hills sometimes reaching even an elevation of 10,000 ft. These plants are mostly perennial and may be called in general weeds including herbs, undershrubs and climbers. Some of them flower throughout the year and some in spring from January to February. Fruits ripen before the rains from March to April. Some of the species more or less dry up in the hot weather. The climax of growth of most of these species reaches within two to three months after the rains—say from September to December. The rapid spread of *Eichhornia speciosa*, *Croton sparsiflorus*, *Eupatorium odoratum* and *Lantana camara* within a fairly short period has become such a menace to cultivation that questions were raised in the local Legislative Councils to find out means for their control and eradication. The question of eradication of *Eichhornia speciosa* (water hyacinth) is still uppermost in our mind. The writer, as hinted in his paper entitled "Role of Aquatic Vegetation in the biology of Indian waters"[2] is of opinion that the eradication of water hyacinth, as also the other terrestrial species, can alone be done by mechanical means and organised labour. I have studied the question of eradication of water hyacinth since it was tackled by Dr. P. Brühl from 1920 onwards. I have had the opportunity of visiting different affected areas in India and Burma. I am convinced that there is no royal road to eradicate this pest save and except by mechanical means. Utilisation of water hyacinth compost as manure is, I believe, not so very tempting to the agriculturists as to induce them to apply their whole-hearted effort for eradication. Manufacture of alcohol from water hyacinth on a commercial scale is rather doubtful, but if it proves successful by the attempt of Dr. H. K. Sen, it might be a tempting offer. In any case in this country under the present circumstances, it appears to me that a certain amount of forced labour or legislation might have, in the beginning, desirable effect to stir up the landholders to take up the work in right earnest. The prospect of utilising water hyacinth as manure, potassium salt, alcohol and other byeproducts might also encourage educated people and zemindars of the affected areas to influence the tenants for exerting their manual labour to the full extent for the eradication of this pest which day by day is leading them to heavy financial losses.

The control of terrestrial pest is not so very complicated, as it requires keen watch in uprooting the plant before the fruiting period. In this way after three or four years weeding they will be quite under control. In the forest areas careful burning of the weeds in proper time will have considerable effect in checking their growth. Thus by careful weeding the author finds large plantations, gardens and estates are kept free from growth of undesirable weeds. In this country edaphic and climatic conditions, vast areas, finance and other labour factors are not favourable to the use of spray and chemicals.

The American plants seem to have particular liking for the Indian soil, so that once they can set foot on any part of India they spread like wild fire in no time. Of such

may be mentioned—the Euphorbiaceous South American *Croton sparsiflorus* which Prain records as occurring in the Royal Botanic Garden in 1904. This alien species was evidently, as Mohr refers in his *Plant Life of Alabama* in 1901, was introduced in ballast and found its way to India *via* Malay Peninsula, South Burma and Aracan sea coast. Both Brühl and Joshi remark that this plant favours riverside and water courses. The writer thinks that this plant first settles down along the river-side, water courses of various sorts and even along the edges of ditches. This is evidently due to its innumerable seeds having been washed down by rainwater are finally distributed by the current of rivers. The seeds thus carried by water are stranded along the margins of watercourses or open chars of rivers and canals and grow there under suitable conditions. In this way the plants are securely placed in their new habitat, and after first fruiting period the cocci are scattered and the area of the spread of this plant increases in mathematical proportion. Its access to Benares is very likely by boats plying in the river Ganges or by human agency or by trains running from Bengal to the Upper Gangetic plain. The writer during his recent tour followed this species down to South Burma where it might have reached by the sea along the Aracan sea coast. Its luxuriant growth in masses forming pure association in open fields in some parts of Bengal sometimes lends a touch to the landscape. It spreads right up to the foot of the Himalayas in Northern Bengal. In South India it has been observed by Mr. V. Narayanaswami that this plant spreads particularly along the Railway lines and embankments and extends up to the foot of the Nilgiri Hills. It is not very common in Bihar and Orissa. It has become a veritable pest in Bengal and it is high time that steps should be taken for its eradication, as its growth increases not only the labour charges but also reduces the fertility of the soil. The species appears to favour moist tropical areas and slightly alkaline soil conditions. The plant is not liked by cattle. *Scoparia dulcis*, another tropical American erect small medicinal herb, unknown in Roxburgh's time, is nowadays common everywhere and extends even up to the Terai region chiefly following the open roads and pathways. This plant belongs to the family of Scrophularineæ. *Eupatorium odoratum*, a Compositaceous plant, known by the local people as "Assam lata," is a tall scandent undershrub introduced after Roxburgh's time from Jamaica, West Indies. Hooker reports its occurrence in Assam, S. Burma and Malay Peninsula. This species is at present wild everywhere in the eastern and southern parts of the Indian Empire. This is the most common plant along the railway lines, in village shrubberies and fallow lands in Assam, Bengal, Southern India and Burma. In Assam, especially along the borders of Sylhet hills and the bases of the Naga Hill ranges, it becomes such a dominant species that it may be called *Eupatorium odoratum* association. Such association is not infrequently met with in the secondary formation of the tropical rain forests of S. Burma. Predominance of its growth is also noticed along the base of the Sikkim, Bhutan, the Garo Hills, Khasia and Jaintia hill ranges and Manipur in the east and Madhupur jungle, Mymensingh, Bengal in the west. It is very likely that the plant might have been introduced from the West Indies to India and Burma by seeds confined to the ballast heaps of Cargo boats calling at Singapore. From the Malayan port the plant found its way into Lower Burma. The line of distribution gradually extends further inland and then bifurcating—one branch extending up the duars of N. Bengal and Assam ranges where it finds ideal condition of growth; and the other to the west Bengal, *via* Chittagong Hill Tracts, Hill Tipperah, Dacca and Mymensingh. It is now making attempts to encroach upon the boundaries of Bihar and further north-west towards upper Gangetic Plain. It rapidly replaces the indigenous shrubby and herbaceous association.

The herb *Ageratum conyzoides* Linn., sometimes known as 'Goat weed' belonging to the family of Compositæ, is a native of tropical America. It follows more or less the same path as that of *E. odoratum*. The plant is a small gregarious herb spreading nearly all over the country except very dry parts—ascends from the sea-level to 8,000 ft. or more in altitude in the eastern Himalayas. The species is abundant in Ceylon too. This species is considered to have been introduced by man to the different parts of the world. *Mikania scandens*, another tropical American plant of the family of Compositæ, unknown in Voigt's time, has of late been a widespread climber. The eradication of this climber is difficult due to its vegetative propagation by roots developing from the

nodes and to its profuse growth of flower heads. Its occurrence on shrubs, trees, bushes and marshy areas even over-choked up tanks, is a familiar sight in the Lower Gangetic and Assam and Burma plains. Hooker reports its occurrence in Assam, Burma and Malay Peninsula. The spread of this climber may carefully be watched by the neighbouring provinces and steps should be taken to prevent its entrance. The Central American *Lantana camara* of the family of Verbinaceæ commonly met with in this province in village shrubberies is a veritable terrestrial pest in the Deccan peninsula and the Carnatic. It is reported to occur in the Lower hill forests of the E. and the N.-W. Himalayas, Bengal, Assam, Burma and the Andamans as well. The plant is seriously interfering with cultivation and forest operation and its eradication has attracted attention of local people. Of recent years the South American species, *Heliotropium curasavicum*, recorded from the Madras Presidency, though grown in Serampore was not mentioned by Prain in his *Bengal Plants*[8] and in his paper on the "Vegetation of the Districts of Hooghly, Howrah and 24 Parganas."[9] Brühl mentions it as 'domesticated in Serampore'. The writer finds it spreading over moist areas of Salt-lakes near Calcutta. It is gradually approaching the town covering sometimes in dense masses large plots of lands. But *Suaeda maritima*, as noted in my paper on the "Flora of salt lakes, Calcutta"[1] gains the upper hand in the struggle for existence between the two species in the salt-lakes proper. The Tropical American Solanaceous plant *Solanum glaucum* is an interesting slender rather tall undershrub with beautiful glaucous linear acute leaves and pale bluish flowers. It has been found growing recently in the neighbourhood of Sundribuns. It has been noticed lately proceeding further inland in the 24 Parganas not very far from Calcutta. It was cultivated in the Royal Botanic Garden in 1899. *Argemone Mexicana*, a native of Mexico, as noted by Joshi, is a common roadside and field weed growing everywhere. This Mexican poppy of the family of Papaveraceæ has already been mentioned in 1875 by Hooker and Thomson in the *Flora of British India*—as "naturalised throughout India". The seeds of this species are disseminated by rain-wash. *Opuntia dillenii*, another American cactus, is confined to the sandy areas especially along the seacoasts of Orissa and drier parts of India, where the spread of this species is so much felt that attempts have been made by the Agricultural Department to kill the plants by means of (cochineal) insects. Dr. H. Pruthi of the Zoological Survey of India has been kind enough to inform me that two cochineal insects, *Dactylopius tomentosus* and *D. indicus* are useful for the eradication of prickly pear (*Opuntia* Sp.). The Loktak lake of Manipur and other marshy areas in Assam are infested with *Polygonum orientale* which is now being replaced by *Eichhornia speciosa.* The representatives of Gramineæ are well known for their long range of distribution and adaptability. I mention here *Anastrophus compressus* only, recorded from this country for the first time by Brühl occurring in the Royal Botanic Garden.[4] Although this plant has been spreading rapidly on the grounds of the Botanic Garden, especially in shady areas, and observed to occur in and about Ballygunge maidan, its spread is not noticed during these years to be so fast as that of its other kindreds.

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Brackish Water Animals of the Gangetic Delta.

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ZOOLOGISTS in Calcutta have been often attracted by the interesting fauna of the Salt Lakes and the Deltaic region of the Ganges. Sixty-five years ago Stoliczka (1869) started researches on these animals which have been followed by Alcock, Annandale, Kemp, Sewell and other past and present officers of the Zoological Survey of India. The results of the researches of these workers are embodied in a series of short papers published in different journals. In the last number of the *Records of the Indian Museum* (**36**, pt. i, pp. 45-121, 12 figs., March 1934), Lt.-Col. R. B. S. Sewell, in his article entitled "A Study of the Fauna of the Salt Lakes, Calcutta", has not only brought together the results of all these researches, but has amplified them considerably by a study of the fauna both in the field and in the laboratory. Though Col. Sewell has dealt mainly with the plankton, with special reference to the Copepoda, in his general treatment of the subject he deals also with the wealth of information that has accumulated regarding other groups of animals.

The geography of the area investigated by the Calcutta zoologists is fully described and it is indicated that for several years past there has been a steady change in the conditions existing in and the general character of some of the rivers in Lower Bengal, and that these changes have had a profound effect on the Salt Lakes and the associated streams and thus indirectly on the general character of the fauna of certain areas. The waters of the Salt Lakes even in 1928 used to be fairly brackish (Salinity 9·60 per mille in February 1928) whereas now they are almost fresh (Salinity 2·20 per mille in February 1933). In consequence, a considerable change in the plankton fauna has been indicated by Sewell.

It is rightly pointed out that "The chief zoological interest in a brackish-water area such as that under consideration lies in the fact that it forms one of the main highways by which certain constituent elements of the marine fauna of the Indian Seas can encroach on and finally establish themselves in fresh water." The main physical factors that the animals have to contend with during the course of migration are: (i) change in salinity, (ii) soft and shifting substratum, (iii) density of silt suspended in water, and (iv) for certain animal associations of this region, periodic desiccation due to tides and other causes. The biological factor, which possibly supplies a stimulus for migration, is the great increase in the available food supply that is found in the region of such estuaries. "The flow of the river brings down with it great quantities of vegetable débris and detritus, that are available as a source of food, and at the same time large quantities of nutrient salts, derived from the land, and poured out into the sea, result in a very large increase in the Diatom flora, that in turn also serves as a food supply for the smaller marine organisms." As there is a great variety of habitats and 'niches' in this environment, the fauna is fairly rich; but it has to be remembered that this environment is full of struggle and strife and demands a great deal of physiological and structural adaptability on the part of the animals inhabiting it. Structural modifications are mainly noticeable in the fish and Decapod crustacea, while striking changes in the physiology and general habits of all animals must have taken place as a measure of adaptation to the varying needs of this environment.

Lists of species in the various animal groups that are known to occur in the Gangetic Delta are given and though these lists are by no means complete, they provide valuable data for further work. A list of stations investigated and the salinity of water at each locality are given. Several new species of Copepods are described and there is an interesting section devoted to the origin of and changes in the Copepod fauna of the Delta. The estuarine fauna, according to Sewell, consists of three elements, marine, relict and freshwater. The majority of the animals that are found in this habitat are, no doubt, derived from the sea and with the exception of fish and other larger animals, specially crabs and prawns, the smaller animals seem to have been brought from the sea to the deltaic region, either as adults or as larvæ, by the action of the tides. Similarly during floods, freshwater animals are carried to these regions and gradually become acclimatised to higher salinity. Moreover,

"In times past, there can be but little doubt, that this region was actually a part of the Bay of Bengal and that with the gradual extension of the Delta seawards the water of the rivers and lakes gradually became less and less salt, though the actual process must have been extremely slow. A certain number of marine species that had established themselves within the area during the early stages of the formation of the Delta would doubtless be able to acclimatise themselves to the gradually changing conditions and thus equally be able to persist in their original habitat and form a relict fauna."

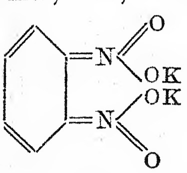
The paper as a whole is a most striking and important contribution, and the author's treatment of the general biological problems connected with this fauna is very clear and stimulating. In a country like India, where there are several estuarine regions, the paper should prove a boon to the general biologist, especially as it contains a big list of useful references. Col. Sewell deserves to be heartily congratulated on this magnificent piece of work.

Letters to the Editor.

Truhaut's Colour Reaction for Uric Acid.

QUITE recently Truhaut (*J. Pharm. Chim.*, 1933, **125**, 339) observed that many compounds having a -CO- grouping in the molecule gave a colour reaction with *m*-dinitrobenzene in alkaline solution. Uric acid is stated to give a stable and characteristic violet colour, when to a warmed mixture of 1 c.c. of 1 % *m*-dinitrobenzene (in alcohol) and 2 c.c. of 10% aqueous sodium hydroxide solution, 0·1 g. of uric acid is added. As a matter of fact, a specimen of "pure" *m*-dinitrobenzene (supplied by Dr. Fraenkel and Dr. Landau of Berlin) gave a positive reaction under the above conditions. No colour reaction was, however, observed after this sample had been repeatedly crystallised from absolute alcohol. *o*-Dinitrobenzene, on the other hand, produced a violet colour even in *very minute* quantities. It is therefore believed that the sample of *m*-dinitrobenzene used by Truhaut was not free from *o*-dinitrobenzene and hence the colour.

The violet colour may be due to the formation of a quinonoid salt (I) (Meisenheimer, *Ber.*, 1903, **36**, 4174), or (II). Prof. W. Lipschitz (private communication) on the other hand prefers the structure (III).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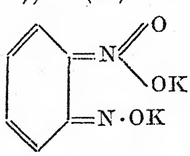
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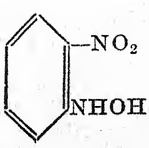
(III)

P. K. BOSE.

Chemistry Department,
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March 8, 1934.

A Note on the Course of Crystallisation of a Basaltic Magma.

IN the study of the order of crystallisation of the different minerals in a cooling magma, according to Dr. Holmes[1] "the real order of formation is most likely to be ascertained from comparative observations on a series of rocks of similar chemical composition which have been quenched at different stages in their cooling history." A very good opportunity for such a study is afforded by an olivine dolerite dyke, occurring near Mysore. This dyke is about 65 feet in width and a good section is exposed in a channel cutting across the dyke. The dyke shows gradual textural changes from a porphyritic basalt at the selvages in contact with the gneissic country rock—to a coarse gabbro with sub-ophitic texture in the centre. The different stages of cooling history are thus clearly revealed, and from a microscopic examination of a series of graded sections from the margin to the centre, it is possible to study the order in which the minerals appeared and the order in which their crystallisation ceased.

[1] A. Holmes, *Petrographic Methods and Calculations*, 1930, pp. 350-351.

Starting from the margin, the early start of the olivine in the crystallisation of the magma is indicated by its occurrence in the selvage rock, as phenocrysts in a groundmass of minute grains of hypidiomorphic pyroxene with interstitial felspar. The study of the groundmass further suggests that the pyroxene started crystallising earlier than the plagioclase. As we approach the centre, the rock becomes a fine grained dolerite with ophitic to sub-ophitic texture. Both the plagioclase and the pyroxene are idiomorphic and the pyroxene often shows evidences of reaction with the magma as revealed by the presence of corroded borders and of reaction minerals like biotite. The material from the centre of the dyke is a coarse gabbro with sub-ophitic texture. The continued corrosion of the pyroxene has effaced any tendency in it towards idiomorphism. The moulding of the pyroxene round the plagioclase suggests that the pyroxene had a longer range of crystallisation than the felspar.

It would thus appear that these observations of ours are distinctly in support of the views recently expressed by Fenner[2] regarding the interpretation of the ophitic texture.

A full account of the rocks including chemical analyses will shortly be published elsewhere.

S. R. NARAYANA RAO.
K. SRIPADA RAO.
Department of Geology,
Intermediate College,
Mysore.
March 12, 1934.

[2] C. N. Fenner, *Journ. Geol.*, **34**, 1926, p. 756.

Sex Control in Papaya.

PAPITA *Carica papayah* is a dieceous tree and about half of the trees are male and half female. Various attempts have been made to eliminate the male papaya and to secure a type which will produce only female plants. Normally flowers in the male are small and are borne in long branching panicles 2 to 3 ft. in length. The flowers in the female tree on the other hand are large and almost sessile and are borne along the side of the trunk in the axils of the leaves.

The fruit is of great commercial value and it is a constant source of trouble to the grower to see about half of his papaya trees develop male flowers. It has been found possible to change the sex by mutilation. At the Hawaii Experiment Station 22 perfectly sterile staminate papaya trees were beheaded. When the new growth appeared on those trees it was found that the trees had become strictly female trees bearing large fruit.[1]

From the Botanical Garden at Jaswant College, Jodhpur, I supplied some papaya seedlings to Mr. G. N. Singhal, Head Master, Darbar High School, Jodhpur. After about a year he complained of all of them turning out to be male. I suggested beheading. Accordingly the plants were beheaded to remove the cluster of leaves at the top, so that no axillary male shoots may develop. This distance is about a foot from the apex. Two new shoots appeared in two cases and only one was kept in each case. Only one shoot developed in each of the other two.

All the four beheaded have developed into strictly female trees. One of them is bearing large fruits. The other is bearing female flowers. The third was killed after it had borne female flowers. The fourth has also produced female flowers.

Beheading according to some observers never produces the desired result. It is advisable, however, to try beheading before cutting the male papaya.

S. SARUP.
Jaswant College,
Jodhpur,
March 12, 1934.

[1] Wilcox, E. V., *Tropical Agriculture*, p. 120, 1916, Appleton & Co., N. York.

A Note on the Life History of *Sagittaria guayanensis* H.B.K.

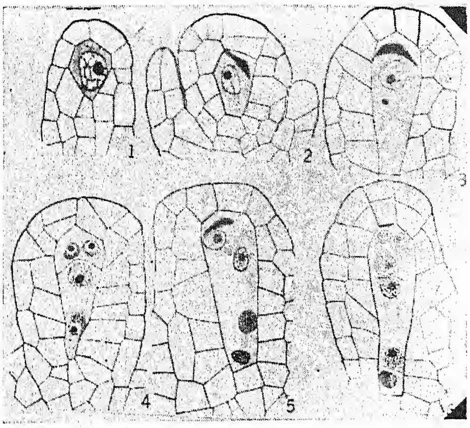
FOLLOWING my observations on the life history of *Limnophyton obtusifolium* Miq. (*Current Science*, 2, p. 12), I have been able to investigate *Sagittaria guayanensis* H. B.K. another member of the *Alismaceæ* collected from Bharatpur. The following is a brief summary of this work.

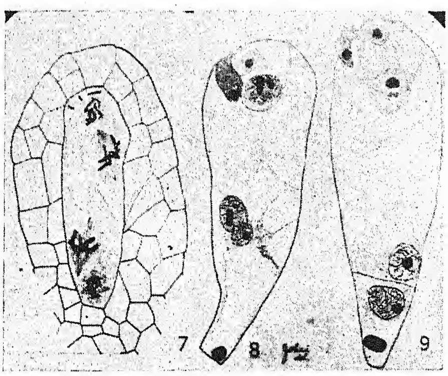
There is a many-celled archesporium in the anther. The tapetum, the endothecium and a single middle layer are formed as usual, by the divisions of the primary parietal layer. The tapetum gives rise to a periplasmodium. The middle layer degenerates very early, even before the mother cells have finished the reduction divisions.

The divisions are successive and the resulting tetrads are usually iso-bilateral.

The microspore nucleus divides giving rise to the tube and generative cells. After some time the nuclei lie free in the cytoplasm. The generative nucleus divides in the pollen grain to form two spherical nuclei, which later on become spindle-shaped. Sometimes, these male nuclei show a clear area around them, but I could not make out a definite cytoplasmic layer round them.

Usually there is a single hypodermal archesporial cell in the nucellus (Fig. 1), but sometimes there are two lying side by side or one above the other. In one case there





was an indication of the presence of three archesporial cells in the same nucellus.

The archesporial cell directly functions as the megaspore mother cell which divides into two cells of which the lower produces the embryo sac. The upper degenerates early (Fig. 2) but in rare cases its nucleus may divide into two before degeneration (Fig. 4).

The nucleus of the lower cell undergoes two divisions to produce a four-nucleate embryo sac (Figs. 3-5). After this stage, only the two micropylar nuclei divide in the majority of cases and a six-nucleate embryo sac is organised as in *Limnophyton obtusifolium* and the other *Alismaceæ* investigated by Dahlgren[1] (Fig. 6). Less frequently one or both of the chalazal nuclei may also divide forming a 7- or 8-nucleate embryo sac respectively (Fig. 7). Such a variation in the number of nuclei has also been reported by Frisendahl[2] in *Elatine*. Evanescent cell plates may occasionally appear on the spindles of the embryo sac (Fig. 6).

All stages of double fertilisation have been seen. The pollen tube as it enters the embryo sac always disorganises one of the synergids. Generally the two polar nuclei and one male nucleus fuse simultaneously (Fig. 8). The fusion nucleus is situated in the middle of the embryo sac a little nearer the chalazal end.

The endosperm is of the Helobiales type. A definite wall is formed after the first division of the primary endosperm nucleus (Fig. 9), as reported by Schaffner[3] on *Sagittaria latifolia*.

The embryo is of the *Alisma-type*.

I am greatly indebted to Dr. P. Maheshwari for his kind help and useful suggestions and criticisms.

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March 24, 1934.

The Band Systems of CdF.

THE spectrum of the molecule CdF as produced in the arc shows a number of band heads which are classified into two systems. One of these, the yellow-green, lies between 5300 and 5550 A.U. This system is degraded towards longer wavelengths. The other, the orange system, lies between 6025 and 6300 A.U. and is degraded towards the shorter wavelengths. The equations representing the two systems are:

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[1] Dahlgren, K. V. O., "Die Embryologie Einiger Alismatazeen," *Svensk Bot. Tidskr.*, **22**, 1-17, 1928.

[2] Frisendahl, A., "Uber die Entwicklung chasmound kleistogamer Blüten bei der Gattung *Elatine*." *Meddelanden fran Göteborgs bot. trädg.*, **3**, 99-142, 1927.

[3] Schaffner, J. H., "Contribution to the life history of *Sagittaria variabilis* (*latifolia*)," *Bot. Gaz.*, **23**, 252-273, 1897.

(1) Yellow-green R_2 heads :—

$$\nu_{\text{heads}} = 18871{\cdot}0 + [672{\cdot}38\,(v'+\tfrac{1}{2}) - 5{\cdot}14\,(v'+\tfrac{1}{2})^2] - [694{\cdot}29\,(v''+\tfrac{1}{2}) - 4{\cdot}96\,(v''+\tfrac{1}{2})^2].$$

(2) Orange Q_2 heads :—

$$\nu_{\text{heads}} = 16558{\cdot}3 + [734{\cdot}36\,(v'+\tfrac{1}{2}) - 5{\cdot}74\,(v'+\tfrac{1}{2})^2] - [698{\cdot}34\,(v''+\tfrac{1}{2}) - 5.36\,(v''+\tfrac{1}{2})^2].$$

The yellow-green system is evidently due to the transition $^2\Sigma \rightarrow {}^2\Sigma$ and the orange to $^2\pi \rightarrow {}^2\Sigma$. The final level $^2\Sigma$ of both the systems appears to be the same though the frequencies of vibration and the anharmonic factors are slightly different. This discrepancy which has also been observed in the case of alkaline earth halides is probably due as Johnson* and Harvey† have pointed out, to the heads being formed at large J values and the distance $\nu_h - \nu_o$ being not constant throughout the system. The dissociation energies derived from these equations favour the following interpretation of the structure of the molecule :—

Cd (5s 5p ^{3}P)+F (2p^5 ^{2}P)=CdF $^2\Sigma$ ground level.

Cd (5s 6s ^{3}S)+F (2p^5 ^{2}P)=CdF $^2\pi$ and $^2\Sigma$ excited.

Details will be published elsewhere.

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R. SAMUEL.
M. ZAKI UDDIN.

Department of Physics,
Muslim University,
Aligarh,
April 10, 1934.

* *Proc. Roy. Soc.*, **A 122**, p. 161 (1929).

† *Proc. Roy. Soc.*, **A 133**, p. 336 (1931).

On the Laws of Spreading of Liquid Drops on Filter Paper.

A LARGE number of experiments with various organic liquids such as alcohols, etc., and water has been recently made in this laboratory to discover the law or laws which govern the spreading of a single drop of the liquid on a filter paper. To prevent the effect of evaporation of the spreading drop, observations are made in a closed chamber kept saturated with the vapour of the liquid.

The liquids, so far studied, show that the velocity of spreading dies down according to two distinct exponential laws which may be put in the forms :—

$$V_d = V_o\, e^{-\lambda_1 d} \quad \ldots \quad \ldots \quad \ldots (1)$$

$$v_d = v_o\, e^{-\lambda_2 d} \quad \ldots \quad \ldots \quad \ldots (2)$$

The second law becomes operative as soon as the influence of the first has disappeared.

A dimensional analysis of λ_1 and λ_2 leads to the following results, namely,

$$\lambda_1 = \frac{C_1}{A} \cdot \frac{(MT)^{1/2}}{\eta} \text{ and } \lambda_2 = \frac{C_2}{v_c} \cdot \left(\frac{T}{M}\right)^{1/2}$$

where M is the mass of the drop; T the surface tension of the liquid: η the coefficient of viscosity; C_1 and C_2 are two pure numerics and A is the area of the filter paper wetted by the liquid until equation (1) holds and v_c is the critical velocity at the distance at which transition from law (1) to law (2) takes place. The critical velocity has been found to be a very definite constant for a given pure liquid, independent of the mass of the drop taken. The results observed completely verify the laws given above.

Further work on solutions of different electrolytes is in progress at present. Full details will be shortly published.

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B. N. GHOSH.

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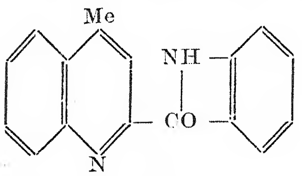
Patna,
April 13, 1934.

The Condensation of 2-Chlorolepidine with Anthranilic Acid.

EPHRAIM (*Ber.*, 1892, **25**, 2710) condensed anthranilic acid with 2-chlorolepidine in absence of any solvent and suggested an anthranil structure (I) for the product, on the ground that the substance could be easily hydrolysed by alcoholic potash to an acid. Backeberg (*J. Chem. Soc.*, 1933, p. 390) supports this constitution without adducing fresh reasons, and finds moreover that the product is the same even when such solvents as nitrobenzene or acetic acid are employed (*cf.* E.P. 321738). Recently the present author in collaboration with Mr. D. C. Sen (*J. Chem. Soc.*, 1931, p. 2840) has studied the condensation of 2- and 4-chloroquinolines with anthranilic acid and has ascribed the general structure (II) to the products obtained



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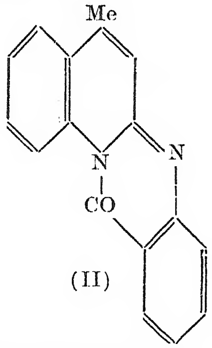


(II)

from anthranilic acid and 2-chlorolepidine. The fact, recorded by Backeberg, that 2-chlorolepidine condenses with anthranilic acid in acetic acid solution supports our view of the mechanism of condensation, inasmuch as anthranil formation does not take place easily. It is also difficult to explain the absence of any anthranil in the condensation of anthranilic acid with 4-chloroquinoline, if the views of Ephraim and of Backeberg be correct. Our arguments have already been put forth and they need not be repeated here. Incidentally it might be pointed out that 4-*o*-carboxyphenylamino-quinaldine and 2-*o*-carboxyphenylamino-lepidine have been previously described by us—a fact which has apparently been overlooked by Backeberg.

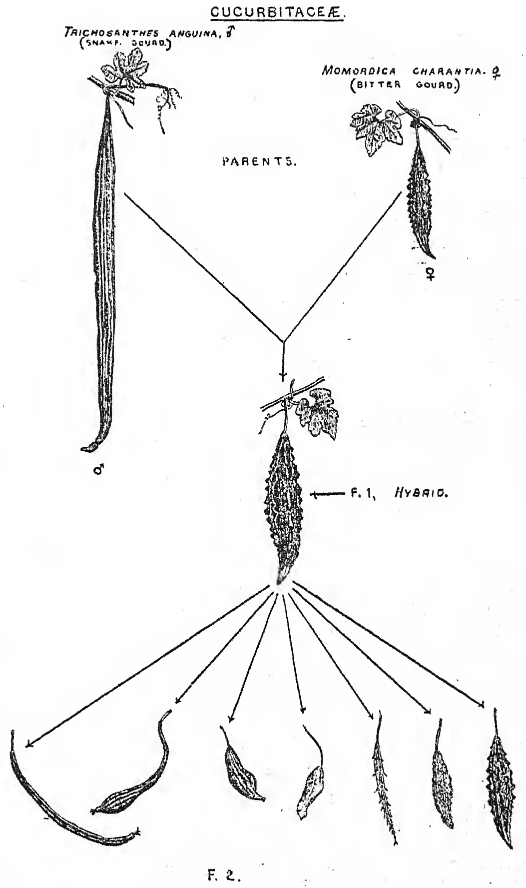
P. K. BOSE.

University College of Science,
Calcutta,
April 20, 1934.

Intergeneric Cross in Cucurbitaceæ.

AT the instance of the Director of Agriculture, Madras, a number of both interspecific and intergeneric crosses have been attempted in cucurbitaceæ. In very many cases, there was no development of fruit.

In one case, however, that between bitter gourd (*Memordica Charantia* ♀) and snake gourd (*Trichosanthes anguina* ♂) over 50% of the artificially pollinated flowers have developed into fruit, the seed of which, when sown, germinated well and produced a normal crop. Reciprocal crosses in these have also been attempted but without success. The seed obtained was sown with over 50% germination and the tender plants were healthy even from the beginning. Except that the plants were more vigorous than the female parent, all the floral and vegetative characters of the bitter gourd were dominant while those of the snake gourd were recessive. The F_1 plants were fully fertile as the fruits which were slightly bigger in size than those of the parent contained fully developed seeds. The seed when sown in the second filial generation germinated well but a large percentage of the seedlings were washed away by floods. The surviving plants came up fairly well after a certain amount of tardy growth in the early



stages and are now bearing fruit. The F_2 segregation has produced interesting combinations—there being gradations not only in form and size of fruit but also in taste. It is too early to say anything more at present and the results of detailed study will be published in due course.

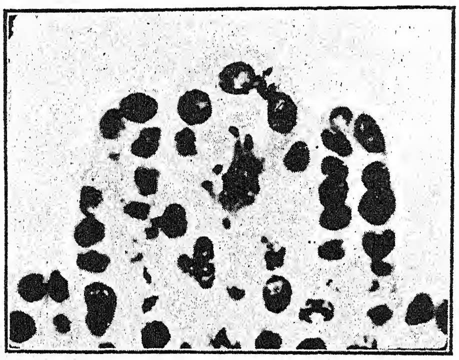
S. SITARAMA PATRUDU.
P. KRISTNA MURTI.

Agricultural Research Station,
Anakapalli.
April 20, 1934.

Sterility of the Female Gametophyte of *Colocasia antiquorum*, Schott.

Colocasia antiquorum is a common aroid of Bengal which grows profusely during the monsoon. It is particularly abundant on the sides of tanks and 'jhils' and also on water-logged areas. The method of propagation is chiefly vegetative. As seed formation in this plant has not been observed under natural conditions, a study of the female gametophyte was undertaken which revealed the following facts:

The archesporial cell is hypodermal in origin and functions as the megaspore mother cell. The prophasic changes in the nucleus of the megaspore mother cell are quite normal. During the heterotypic metaphase a bipolar spindle is formed, but the chromosomes lie irregularly clumped in the centre and their distribution to the poles is very irregular, as shown in the accompanying photomicrograph.



Heterotypic division of the megaspore mother cell. ×1100

Degeneration of the megaspore mother cells is first noticed at this stage. Those which do not degenerate undergo the homeotypic division, which is characterised by the same irregularities as was observed during the reduction division. The homeotypic spindles are separated by a distinct wall. Degeneration at this stage is also sometimes observed. As a result of the homeotypic division four macrospores are produced which are arranged lineally and separated by distinct walls. Degeneration of all the macrospores at this stage in the development of the ovule is very commonly met with. The degenerated macrospores appear as dark streaks in the centre of the nucellus. Sections of fully opened flowers and flowers still older invariably show crumpling of the ovules and the absence of the female gametophyte in the nucellus, which is composed of a few layers of cells and is bounded by the integuments.

It is interesting to note that recently Maeda[1] has observed irregularities in the reduction division of this plant and he believes that probably this might be the cause of sterility. A full account of the investigation will be published elsewhere.

I. BANERJI.

Botanical Laboratory,
Calcutta University,
April 23, 1934.

Loss of Nitrogen from Swamp Soils.

FOLLOWING the classical researches of Gayon and Dupetit on denitrification in sewage, a number of workers have suggested the possibility of similar changes occurring under the 'anaerobic' conditions prevalent in swamp soils. There is very little experimental evidence, however, to support such a theory: nor is denitrification, as commonly understood, likely to play any important part in swamp soils because the latter seldom contain more than traces of nitrates.

In the course of an investigation on carbon and nitrogen transformations attendant on the application of substances with different C–N ratios to swamp soils, it was observed that there was practically no loss of nitrogen during the initial stages of fermentation. There was, on the other hand, considerable production of ammonia especially from substances with narrow C–N ratios. This was followed by a period of slow nitrification when considerable loss of total nitrogen was noticed. The last observation being contrary to the previous conceptions, a series of systematic studies were carried out, following the changes in different forms of nitrogen at weekly intervals.

It was observed that (*a*) ammonia was generally produced at a faster rate than nitrate, so that fairly large quantities of the former tended to accumulate in the medium (Fig. I), (*b*) loss of total nitrogen proceeded simultaneously with the mineralisation of nitrogen, and (*c*) ammonia was the chief nitrogenous product among the gases evolved and accounted for the major part of the

[1] Maeda Yosinori, *Proc. Crop. Sc. Soc.*, **4**, 1932 (Abstract from *Jap. Jr. Bot.*, 1933, **4**, 3, Abst. No. 258).

nitrogen lost from the soil system (Fig. II). Further study of the conditions relating to the loss of ammonia showed that the soil reaction which had become fairly acid (P_H 5·3) and contained useful amounts of free organic acids (chiefly lactic and acetic) tended to revert to that of the original soil (P_H 7·6) in the later stages. The change in reaction combined with the increasing concentration of ammonia would appear to have facilitated the volatilisation of the latter.

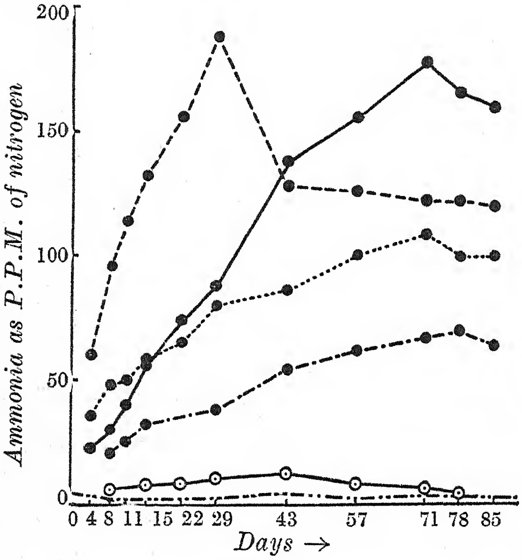


Fig. I.

Production of ammonia from equivalent amounts (in terms of nitrogen) of substances with different C-N ratios.

Cyanamide	$(\frac{C}{N}=0{\cdot}9)$
Dried blood	(,,=3·3)
Urea	(,,=0·4)
Hongay leaf	$(\frac{C}{N}=13{\cdot}8)$
Farmyard manure	(,,= 9·2)
Control (untreated)	(,,=10·0)

Parallel studies conducted under dry soil conditions showed that similar loss by volatilisation of ammonia also occurred in such cases (Fig. II). The quantities thus lost were, however, generally less than those observed under swamp soil conditions.

Further work is in progress to determine the extent to which loss of ammonia by volatilisation occurs in presence of the growing plant. Attempts are also being made to standardise the conditions for the addition of different organic manures so

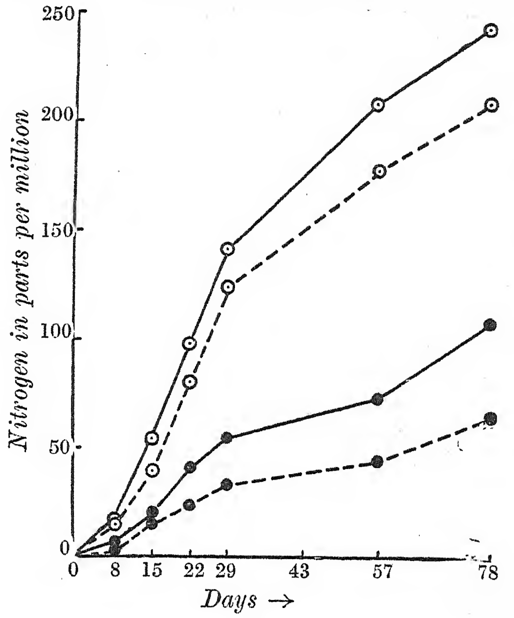


Fig. II.

Loss of total nitrogen and volatilisation of ammonia.

Total nitrogen lost under dry soil conditions
,, ,, ,, ,, swamp ,,
Ammonia (as nitrogen) lost under dry soil conditions
,, ,, ,, ,, ,, swamp ,,

that while mineralisation of nitrogen proceeds unhampered, the resulting products would be retained in the soil system and become available when required by the growing plant.

A. Sreenivasan.
V. Subrahmanyan.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
May 4, 1934.

Absorption Spectrum of SCl_2.

The absorption spectrum of SCl_2 vapour has been studied under different conditions. It shows at first a continuous absorption in the violet region at about 4100 A.U. Between 3400 and 2750 A.U. a well-developed band system appears and then two more continuous absorption regions between 2600 and 2400 A.U. and from 2280 till the limit of the transmissivity of the quartz apparatus have been observed. The spectrum and also the process of primary dissociation

appears to be quite different from that of Cl_2O. A full report will be given elsewhere.

R. K. ASUNDI.
R. SAMUEL.

Department of Physics,
Muslim University,
Aligarh.
May 5, 1934.

The Distances of the Closest Approach of Atoms of Rubidium, Caesium and Barium.

IT is known that rubidium and caesium react with water at the ordinary temperature and so also barium.* Therefore according to the author's rule† for the reactivity of metals with water which states that only those metals would react with water at the ordinary temperature which have the distances of the closest approach of their atoms above 3·00 Å, it seems that all these three metals would have values, which are not available, for the distances of the closest approach of their atoms above 3·00 Å.

This view, it may be noted, is confirmed by the calculation of the distances of the closest approach of atoms of these elements with the help of the author's formula‡ which has proved helpful in rendering some explanation of the formation of amalgams with mercury§ and has given atomic approach values agreeing closely with the experimental ones in nearly a dozen (eleven) elements.

The formula may be represented by

$$D = \frac{P}{V_i \times d^{K/V}}$$

where D is the distance of the closest approach of atoms of the elements in question, P its parachor; d, its atomic diameter; V_i, its ionisation potential and K, a constant having the value 1·58. The calculated atomic approach values which this formula has given is indicated below:

Element	Parachor	Atomic Diameter	Ionisation Potential	Valency	K/V	Closest approach of atoms	
						$D_{calc.}$	D_{found}
Rubidium	130‖	3·38¶	4·16††	1	1·58	4·56	—
Caesium	150‖	3·36¶	3·88††	1	1·58	5·7	—
Barium	160‖	4·20**	5·19††	2	0·79	6·57	—

It will be evident from the above table that in the case of all the three elements the calculated values for the distances of the closest approach of their atoms are above 3·00 Å which confirms their ability to react with water at the ordinary temperature. Further, it may be pointed out, since the formula has given values which agree well with experimental ones in a good number of cases and since the values obtained in the present cases are in conformity with the behaviour of these elements with respect to water, the calculated values may seem to represent the experimental ones for which no distinctive data appears to be available.

BINAYENDRA NATH SEN.

Chemical Laboratory,
Presidency College, Calcutta.

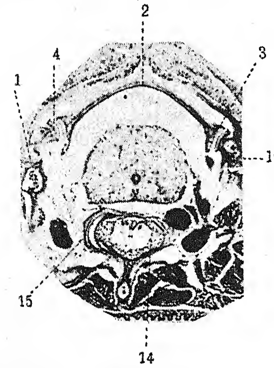
* Mathiessen, *Journ. Chem. Soc.*, **8**, 294, 1856; Davy, *Phil. Trans.*, **98**, 1, 333, 1808.
† Sen, *Nature*, **129**, 585, 1932.
‡ Sen, *Zeit. Anorg. Chem.*, **212**, 410, 1933.
§ Sen, *Chemical News*, **145**, 93, 1932.
‖ Sugden's *Parachor & Valency*, p. 181.
¶ Lorenz, *Zeit. Phys. Chem.*, **73**, 253, 1910.
** Bragg, *Phil. Mag.*, **6**, 40, 169, 1920.
†† Taylor, *A Treatise on Physical Chemistry.* (New Ed.), II, 1203.

On the Development of the dorsal-arcualia, zygosphene and zygantrum in the Vertebral Column of Snakes.

PREVIOUS investigators[1 and 3] on the development of the vertebral column of snakes,

[1] Brünauer, V. E., *Arb. Zool. Inst. Wien.*, **XVIII**, pp. 1–24, 1908-10.
[2] Mookerjee, H. K., *Phil. Trans. Roy. Soc.*, B. **218**, pp. 415-446, 1930.
[3] Schauinsland, H., *Handbuch der vergl. u. experim. Entwicklungslehre der Wirbeltiere. von Oskar Hertwig*, **3**, pp. 339-572, 1906.
(In this paper the list of all the previous papers could be found.)

have stated that the dorsal-arcualia are formed from the basidorsals of either side which eventually meet at the mid-dorsal line to complete the arch. Basidorsals start as membraneous structure, then become cartilaginous and ultimately become



×79 **Fig. I.**

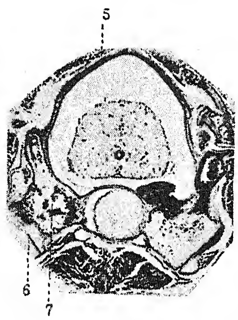
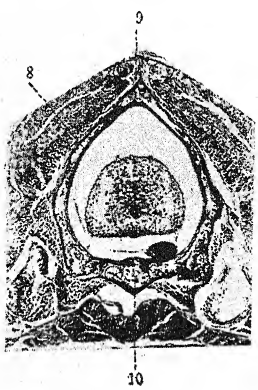


Fig. II. ×79



×75 **Fig. III.**

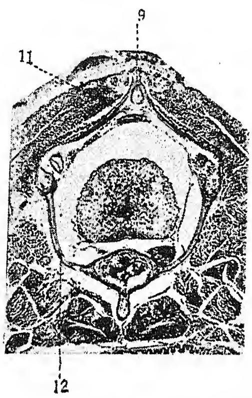


Fig. IV. ×75

Figs. I—IV. Serial transverse sections through different regions of a trunk vertebra of *Tropidonotus stolatus* at 12 cm.

1. Prezygapophysis; 2. Part of the anterior connective tissue arch; 3. Zygosphene; 4. Zygantrum; 5. Anterior connective tissue arch; 6. Rib; 7. Rib-bearing process; 8. Basidorsal (with marrow cavity); 9. Supradorsal; 10. Centrum; 11. Trace of connective tissue arch; 12. Posterior connective tissue arch; 13. Neural spine; 14. Condyle of the vertebra; 15. Socket of the vertebra; 16. Postzygapophysis.

osseous; but we have found a different story altogether. One of us[2] has shown that in the vertebral column of *Urodela*, corresponding to each vertebra basidorsals are situated at the middle region of the centrum and at the anterior and the posterior portions of it there are two connective tissue arches which without undergoing through the stage of chondrification become osseous. These anterior and posterior connective tissue arches are thinner in cross-section than the basidorsals.

Likewise in the vertebral column of snakes we get the anterior and posterior connective tissue arches which are also thinner than the basidorsals in cross-section, and the two limbs of each arch stand at right-angles to the centrum and are not round like the basidorsals, so that the latter bulge out more on the sides over the spinal cord than the connective tissue arches (Figs. II and IV). In *Urodela* there are two fibrous layers at the intervertebral regions which are connected with the prezygapophyses and the joints of the centrum at the bottom, to allow flexibility of the vertebral column.

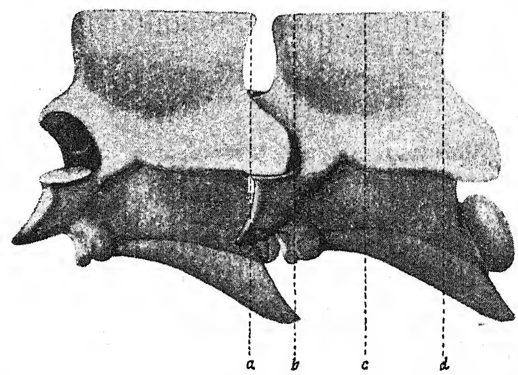
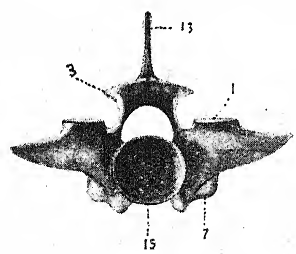


Fig. V. ×30

Side view of the two consecutive adult trunk vertebræ of *Tropidonotus stolatus*.

a, *b*, *c*, *d* are the planes through which Figs. I to IV have passed.



×20 **Fig. VI.**

Anterior view of an adult trunk vertebra of *Tropidonotus stolatus*.

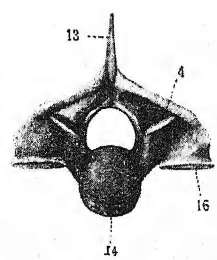


Fig. VII. ×20

Posterior view of an adult trunk vertebra of *Tropidonotus stolatus*.

In the vertebral column of snake the anterior connective tissue arch joins with the posterior connective tissue arch of the previous vertebra, forming two points of articulation and, therefore, in a transverse section passing through the intervertebral portion two additional dorsolateral articulations are found which are called zygosphene

and zygantrum respectively, so that flexibility of the vertebral column of snake is also possible (Fig. I). The anterior and the posterior connective tissue arches together with the cartilaginous basidorsals become osseous like *Urodela*, and here also the connective tissue arches do not pass through the stage of chondrification. Another important point to be noted here is that the basidorsals of either side do not meet at the mid-dorsal line, but there is, as in *Urodela*, a third piece which should be called supradorsal (Fig. III). On the dorsolateral sides of each supradorsal in the region of the posterior end, there are two cartilaginous elements forming postzygapophyses at the intervertebral region like *Urodela*. So that a transverse section passing through the intervertebral portion shows supradorsal at the top, postzygapophyses with cut ends of prezygapophyses of the next vertebra at the dorsolateral corners and dorsal to them a portion of the anterior connective tissue arch with zygosphenes and also zygantra of the previous vertebra. For the sake of comparison we have given the side view of two consecutive adult trunk vertebræ and have marked there the planes through which the transverse sections would have passed (Fig. V). Figs. I to IV more or less correspond with the markings on the adult vertebræ. Figs. VI and VII are the anterior and posterior views of the adult trunk vertebra.

HIMADRI KUMAR MOOKERJEE.
BIMAL KUMAR CHATTERJEE.

Department of Zoology,
University of Calcutta,
Calcutta,
April 20, 1934.

Salt Tolerance of Plants as Induced by Pre-treatment of Seeds.

THE Homeopathic system of therapeutics rests on two main principles: (1) that 'like be cured by likes', and (2) that the remedies be administered usually in minute doses. The latter fact has a close parallel in the agricultural practice of fertilisers, where the dosages of the active ingredients added are extremely small as compared to those already present even in the poorer soils. This gave rise to the speculation, if the first principle of Homeopathy that 'like be cured by likes' could in anywise be utilised to serve some necessities of plant life.

As an initial experiment, it was proposed to try the possible application of this principle to the successful production of plants on salt lands. There was a considerable mortality of seedlings in saline soils. May be the plants otherwise healthy, developed certain fatal symptoms due to the presence of certain salt or salts in the soil. Were it so, it was held possible to save them by administering identical salts in minute doses. By the same law, if a plant already affected by the given symptoms be now sown in a saline soil, it is as probable that the salt in the soil will now prove a remedy; in other words, the salt tolerance capacity of the plant will greatly increase.

To test the correctness of these assumptions a series of laboratory experiments were conducted with wheat, *Dolichos lablab*, *Sorghum* and barley. In the first series, only the treatment of seeds was undertaken, while the treatment of seedlings and plants was left over for the second. As the saline soils in Sind contain chiefly the chloride and the sulphate of sodium, experiments were restricted in the present instance to the use of chloride of sodium only.

The method in the main was to first induce the supposed symptoms in healthy seeds, by treating them with NaCl solutions of different homeopathic concentrations (ranging from $0{\cdot}35$ to $\frac{0{\cdot}35}{10^{18}}$ %). The seeds so treated were sown in sand cultures at 25 per cent. moisture and containing the same salt NaCl in such percentages as are commonly found to be present in the salt lands in Sind. A study of the percentage germination in the different cases was made with the following results:—

Table showing average percentage germination of wheat seeds, treated with salt solutions of different concentrations and sown in sand cultures with and without salt.

In the sand culture	Seeds untreated	Seeds pre-treated with water only	Seeds pre-treated with salt solutions of various minute concentrations
No salt	100	100	100
NaCl 0·4%	65	80	100
,, 0·5%	40	57	70–90
,, 0·6%	15	20	20–75

In a pure sand culture (without any salt in it) the germination is cent. per cent.

whether the seed is treated or not. But once the salt is introduced into the culture, the germination of the seeds is affected, the larger the amounts of salt the lower being the germination.

Now where the seeds were pre-treated with salt solutions and then sown in salt lands, it is seen that for a given salt content in the culture the germination is generally better than in the controls (seed untreated). Also soaking in water alone has given a slight advantage to the seeds in germination.

It has also been found that the percentage figures of germination obtained with seeds treated to successive dilutions and sown in sands with the higher percentages of salt, *viz.*, 0·5 and 0·6%, arrange themselves roughly into a parabolic curve when plotted against dilutions, the medial dilutions tried giving about the best results.

It is indeed interesting that the germination of wheat seeds was raised from 40 to 90% in sand with 0·5% salt and from 15 to 75% in sand with 0·6% salt, by the pre-treatment of those seeds with a solution of the same salt as was present in the sand culture, in a given concentration ($\frac{0.35}{10^{10}}$ %). Similar results have been obtained in all the repeated trials made to confirm the original results.

Because of the striking consistency and promise of the data the work is being continued in pot culture and on small plot scale. No claim is made that definitely 'like has been cured by likes' but it is suggested that the physiological and biochemical aspects of the phenomenon deserve a systematic inquiry.

V. A. TAMHANE.
M. A. SHAMA IYENGAR.
Chemistry and Soil Physics Department,
Agricultural Research Station,
Sakrand.

Propagation of Radio Waves.

By B. C. Sil, M.Sc.,
Station Engineer, Indian State Broadcasting Service, Calcutta.

AS one interested in the subject of the Propagation of Radio Waves, I have read with interest the address on the same by Prof. S. K. Mitra, President of the Mathematics and Physics Section of the last Science Congress and also the review thereof which appeared in the January issue of the *Current Science.* As I am unable to agree to some of the views expressed by your reviewer, I would request you to allow me a little space to say a few words regarding them.

In dealing with the topic of long wave propagation Prof. Mitra remarks that when certain conditions regarding the transmitting aerial such as the power available, etc., are combined with the Austin-Cohen formula, it is found that the best working wavelength is about 1/500th part of the distance separating the transmitting and the receiving stations. Your reviewer takes exception to this statement and doubts if it has any substantial basis. As far as I am aware, this simple and approximate rule is well known to practical radio-telegraphists, and, for a statement of it I would refer your reviewer to *Taschenbuch der drahtlosen Telegraphie and Telephonie*, edited by F. Banneitz, (published by Julius Springer, Berlin, 1927), page 387, and also to a paper by H. Rukop read at a meeting of the Deutsche Gesellschaft für Technische Physik, Danzig, in September, 1925 and published in the *Telefunken Zeitung*, January, 1926.

Your reviewer's remark that no conclusive evidence exists to definitely support the assumption of transmission of long waves by multiple reflection and of short waves by long-step process is indeed surprising. The fundamental difference between the modes of propagation of long and of short waves as pictured in Figs. 5 and 6 of the address, and as is envisaged by the Eccles-Larmor Theory is now so well recognised that it has found place in such modern text-books as *Wireless* by Turner (pages 51, 53) and *Radio Engineering* by Terman (pages 561, 568, 571). An elaborate treatment of the whole subject is to be found in *Propagation of Radio Waves* by Pedersen, pages 194-200. An evidence, as conclusive as is possible under the circumstances, is to be found in a recent paper by Holingworth referred to by Prof. Mitra in his address (Ref. No. 25).

Regarding Fig. 11, I think it is sufficiently explained in page 21. As mentioned there it is a rough picture of the variation of the equivalent electron content with height. The heights of the region of low density between 80 and 250 km. are obviously related to those of high density and should naturally change with the changes of height of the latter with the hour of the day and season of the year. The broken-line portions of the curve are evidently for regions inaccessible to experimental investigation and the full-line portions—since the figure is only a rough picture—obviously depict the observed values and also the probable values as may be deduced from other observations.

Your reviewer is surprised at the low value of electron density immediately under the maximum of the E region (at 80 km.) and also in the region between the intermediate maxima. There is nothing surprising in this for the following reasons. Firstly, the density gradient near the lower boundary of these regions (E, E′ and F′) is extremely high. (See page 20 and Fig. 10 in the address; Ref. No. 48, paper by Appleton and Naismith

and also *J. I. E. E.*, **73,**, Oct. 1933, paper by G. Builder. The gradient is so steep that a variation of equivalent electron density from 1.7×10^5 to 4.1×10^4 takes place within a distance that cannot be sensibly measured.) If this gradient is maintained then evidently the density will fall to a very low value within a distance of a few kilometres. Secondly, so far as radio wave propagation is concerned, a density of 10 or 100 per c.c. is by no means low. A uniform rise of electron density from 0.0 to 0.3 at such heights is sufficient to produce enough curvature in the ray path of 1 km. wave to make it girdle the earth (see Ref. No. 24, Larmor's paper); and an electron density of only 1 per c.c. at a height of 80 km. is capable of bending back to earth 5000 m. waves leaving a transmitting ærial horizontally! Thirdly, an equivalent electron density of say 100 does not mean that the region is devoid of heavier ions. This density for the purpose of radio wave propagation is equivalent to a density of 2.4×10^6 per c.c. of atomic nitrogen (see page 19 of the address); for all we know the regions of "low" electronic density might be filled with nitrogen ions having density of the above-mentioned order.

Regarding broadcasting on 10 metres, your reviewer finds it difficult to understand why the question of upwardly directed rays has been brought in because, surely, he argues, the aerial system would not be deliberately designed to radiate upwards! His difficulty would disappear if he recalls that an ordinary broadcasting aerial not only radiates horizontally but also at all angles inclined to the vertical.

In discussing absence of fading on such short waves Prof. Mitra rightly remarks that the radiated waves pierce the ionosphere at all angles of incidence and there being no reflected wave the chief source of fading is eliminated. Your reviewer, however, takes exception to this statement and says that even at such low wavelengths penetration of the ionosphere by the radiated waves does not take place at all angles of incidence. I wonder on what grounds this statement is made. If your reviewer is referring to the case of waves radiated from an aerial planted on the surface of the earth then certainly his statement is incorrect and is against known facts (see *Wireless* by Turner, page 51). If, however, your reviewer is referring to the case of an aerial taken hundreds of kilometres above the surface of the earth and placed in the ionosphere itself then the statement is probably true. But it is doubtful if in discussing broadcasting on 10 m. Prof. Mitra intended that the aerial system should be situated in the ionosphere!

For those not in possession of copies of the address it would be difficult to follow either the comments made by your reviewer or the reply thereto in this letter. But I am sure those interested in the subject will find no difficulty in procuring copies of the same, which, as mentioned by your reviewer, presents a survey of the present day knowledge on the transmission of radio waves round the earth.

* * *

Thanks are due to Mr. Sil for his references to the hand-book edited by Banneitz and to Rukop's address of 1926 on the question of the optimum wavelength of a transmitter for a given distance.

1. In a matter involving a wide variety of physical conditions, any worthwhile relation between wavelength and distance should be based on the results of measurements on the transmissions from a number of stations located in different parts of the world. For instance, does the 1/500 rule find support in the data collected by Austin and his successors at the Bureau of Standards during the past dozen years? What, again, is the experience of the radio authorities of France, Great Britain and the United States?

2. In regard to long distance propagation, it is not clear as to what is "the fundamental difference between the modes of propagation of long and short waves....as is envisaged by the Eccles-Larmor theory." The brief reference in Turner's book and the discussion by Pederson of the possible methods of propagation cannot form adequate basis for the assumption of transmission of long waves by multiple reflections and of short waves by the long hop process. Prof. Hollingworth's paper is a preliminary statement of his observations with, as he himself says, some tentative conclusions. There is as yet no body of accepted facts which can be taken as conclusive evidence one way or other.

3. The electron density at different levels of the earth's higher atmosphere is still a subject of discussion and investigation. Information was sought in respect of any theoretical considerations or experimental data helping to account for the low densities at certain levels of the ionosphere.

4. It is not easy to understand Mr. Sil's remarks on the location of the antenna. There is nothing in the review to indicate that any locality beyond the immediate neighbourhood of the ground was under consideration.

5. The conditions necessary for bending back very low wavelengths such as 10 metres are obtained by the same equation that Mr. Sil uses to show that an electron density of 1 per c.c. is enough to reflect a 5,000 metre wave if it leaves the transmitting antenna tangential to the earth's surface.

The reviewer may be pardoned for pointing out that far from taking exception to any statement or entertaining a feeling of surprise at anything in Prof. Mitra's address, the review merely expressed genuine doubts and sought information on aspects of radio wave propagation which are still under investigation. Further no views of any kind were expressed except in the last para on the question of broadcasting.

9th April, 1934. REVIEWER.

Recent Advances in Anthropology, Ethnology and Ethnography in India.

By Dr. B. S. Guha,
Anthropologist, Indian Museum, Calcutta.

In his otherwise well-informed account of the "Recent Advances in Anthropology, Ethnology and Ethnography in India" published in the January issue of the *Current Science*, it is regretted that Rao Bahadur L. K. Ananthakrishna Iyer should have made no reference to the works of several important investigators. I have no doubt that this omission was unintentional but if such accounts are to be considered as authoritative it is essential that due mention be made of all important contributions. I give below a summary of some of the anthropological works that have not been included in the above account.

Lt.-Col. Alberto C. Germano da Silva Correia has been carrying on investigations in the Ecole de Midicine de Nova Goa, on the somatic characters of the inhabitants of Portugese India and has published several memoirs, such as (1) *Les Ranes de Satary* (1928), (2) *Les Lusos-Descendants de l'Inde Portugaise* (1928), and (3) *Les enfants et des adolescents luso-descendants de l'Inde Portugaise* (1931). Dr. da Silva Correia's work has been regarded by European anthropologists as of very great importance and he has been the recipient of many honours in recognition of the valuable researches carried on by him in this country. He has further been instrumental in training several students, one of whom Dr. Voicunte Camotin has published an important anthropometric study of the Saraswat Brahmins, *viz.*, *Os Bramanes Sarasvatas de Goa*, 1929.

Mr. K. P. Chattopadhya, Education Officer of the Calcutta Corporation, has published two papers of great merit on Social Anthropology, namely, "The Social Organisation of the Satakarris and Sungas" (1929) and "Contact of Peoples as Affecting Marriage Rules" (1931). In the latter paper Mr. Chattopadhya has been able to offer a more comprehensive theory of Social Organization than was advocated by Rivers in the light of the recent discoveries of the Pentecost and Ambrym marriage rules.

Dr. Provash Ch. Bose, of the Department of Racial Biology recently opened in the Bose Institute of Calcutta, has within the last few years published a number of papers on physical anthropology and has received commendation from European scientists. At present he is engaged in carrying on an anthropometric survey of the aboriginal tribes of Chotanagpur and a preliminary account of it was recently published in the *Transactions of the Bose Institute*.

Mr. B. K. Chatterjee of the Anthropological Laboratory of the Zoological Survey of India has carried out an elaborate study of the somatic affinities of the Behari Brahmins; this is soon appearing as No. 2 *Anthropological Bulletin* of the Zoological Survey of India.

Dr. Irawati Karve, a pupil of Dr. Ghuriye, has recently returned after taking the Doctorate degree in Anthropology from the Berlin University where she worked under Prof. Eugen Fischer. The results of her investigations on the eye colour of the Chitpavan Brahmins published in the *Zeitschrift für Morphologie und Anthropologie* (Band XXIX, 1931) has greatly added to our knowledge of the significant distribution of this trait among the Konkanasth Brahmins of Western India.

Lastly, Mr. P. O. Bodding's work on the Santali language and folklore and Prof. P. C. Mahalanobis' statistical study of Indian anthropometric data require mention. The former has devoted his entire life to this work and the Norwegian Institute of Human Culture has recently published a sumptuous volume from his pen. A great portion of Prof. Mahalanobis' statistical analysis of the anthropometric data taken by the late Dr. N. Annandale has been published in the *Records of the Indian Museum* and the rest is expected to be completed soon.

Research Notes.

Phase Boundary Potentials.

It has frequently been suggested that surface reactions and surface equilibria are to a large extent controlled by the potential differences (P.D.) which exist at the phase boundaries. In Monograph No. 83 of *Actualities Scientifiques et Industrielles* (Hermann et cie Paris, 1934), E. K. Rideal has critically surveyed the present state of our knowledge on the subject of phase boundary potentials. The earliest type of phase boundary potential known is that recognised by Volta in 1808 at metal to metal interfaces. This Volta P. D. ($\bar{V}$) is modified by the presence of a film on either metal such that if Δv be the potential across the film, the new volta potential $\bar{V}_1$ will be $\bar{V}_1 = \bar{V} + \Delta v$. E. K. Rideal and his colleagues have developed a technique to measure with precision the P. D. between two metals suspended in a gas after ionising the gap between the two surfaces by means of short range α-particles from polonium. With this apparatus they have been able to study the effect of surface films on the volta potential and thereby obtain interesting data on the adsorption isotherm of a polarisable vapour such as ethyl alcohol on gold, and on the rates of evaporation of unimolecular films from metallic surfaces both pure and contaminated. The results indicate that the effect of poisons on the

volta potential of catalytic surfaces may alter considerably the critical energy increment for the surface reactions.

Similar measurements of the effect of film forming materials on the phase boundary potentials at air-liquid interfaces have yielded a number of important generalisations. The different phases in which films can exist show different characteristic molecular contributions to the phase boundary P.D. defined by $\mu = \Delta \bar{V}/4\pi n$ where $\Delta \bar{V}$ is the change in the phase boundary P.D. caused by the presence of n molecules per sq. cm. The values of μ which are determined mainly by the polar groups in the molecule, are further influenced by the presence and position of double and triple bonds in the hydrocarbon chain. The measurements also yield information regarding the molecular arrangement of high molecular weight complex bodies such as the long chain polypeptide units of gliadin, at an air liquid interface. Further the course of chemical reactions actually taking place in the phase boundary could be followed by observations of the rate of change in the phase boundary P.D. Such reactions at liquid interfaces are of special importance because of the many biological implications.

Not much is known about the phase boundary potential at liquid-liquid and liquid-solid interfaces. As is well known, the P.D. between a metal and a solution containing its ions involves the volta potential as well as the difference in free energies between an adsorbed ion and one in solution. If the electrolyte is insoluble in one phase but readily adsorbed at an interface a true phase boundary potential should result. This is probably the case for the glass electrode of Haber when placed in a solution containing metallic ions, *e.g.*, Ag^+ which are strongly adsorbed although the electrode is reversible for H^+ ions which are distributed in both aqueous and non-aqueous phases, the thermodynamic concentration remaining constant in the glass.

It is hoped that more investigators will be attracted to this interesting field.

M. A. G.

Heavy Water and Tumour Growth.

THE production of heavy water in quantities easily available for experimental purposes, has stimulated work on its biological properties. Taylor, Swingle, Eyring and Frost reported that in concentrations ranging from 85–100 per cent., heavy water possessed marked toxic effects on fresh water organisms. Lewis found that 99 per cent. heavy water completely inhibited the germination of tobacco seeds. With the accumulation of larger supplies of water at Princeton, arrangements are now being made to ascertain its effect on the growth of cancer cells.

The work of Saguira and Chesley on the effect of heavy water on the viability of mouse sarcoma and melanoma is of great interest (*Proc. Soc. Exp. Biol. and Med.* **31**, 659–660). These authors have shown that at concentrations of 14·8 and 40 per cent. heavy water, the proliferating capacities of the tumours, mouse sarcoma 180, and the Passey mouse melanoma are unaffected. The tumour fragments which had been immersed in Locke-Ringer solution made up in ordinary and in 40 per cent. heavy water grow normally when transplanted into animals. Histological examination of a number of tumour tissues after immersion in heavy water and ordinary distilled water were essentially similar in swelling, jelly-like appearance, and the hydropic degeneration of the cytoplasm with nuclear degeneration.

Petalody in *Thespesia populnea* Cav.

WHILE giving specimens of *Thespesia populnea* for class work, a flower was observed in which two of the stamens were transformed into petaloid structures. The rest of the stamens of the staminal column were quite normal both in their number and their size. Nor were any transitional stages from normal stamens to petaloid structures to be found. A search was made of the rest of the flowers but no case of petalody could be seen. About a hundred and fifty flowers from the tree from which these were got, were also scrutinised, but with the same result.

Petalody which is the transformation of the primordia of the stamens into petals, is a terratological phenomenon brought about by pathological (De Bary) or physiological (Goebel) causes. The sporadic transformation of a few stamens into petaloid structures in this case would appear to be due to some pathological cause by which certain localised portions, *i.e.*, a couple of stamens, assume a petaloid expansion—a form which first indicated the foliar nature of the stamen.

Recently a case of petalody of the entire androecium of the cotton was recorded by Sankaran (*Madras Agricultural Journal*, **19**, No. 3), and I learn from the author that it has subsequently proved to be a case of floral mutation.

T. S. R.

Gametogenesis of *Senophylax stellatus*.

R. A. R. GRESSON (*Proc. Roy. Soc. Edin.*, **LIII**, Part IV, R.P. 322–346) describes the oogenesis in this Trichopterid insect, especially the behaviour of the cytoplasmic inclusions. He has determined that the nucleolar activity is very great and that fragments of the nucleolus which are found in the cytoplasm probably give rise to albuminous yolk. But the nucleoli do not contain chromatin as revealed by Feulgen's technique. The Golgi bodies which are in the form of rings or granules are, in the young oocytes, situated at one pole of the nucleus but increase in size and number as the oocyte grows and become distributed in the cytoplasm. They give rise to fatty yolk as in the majority of insects. It is suggested that the material derived from the ooplasm is added on to these globules of fatty yolk formed by Golgi. The rôle of mitochondria is not clear. In fact they are seen with great difficulty on account of their small size and the large number of yolk globules that fill the cytoplasm. Probably they add to the formation of protein yolk. The chromosome number is sixty and while in the younger stages of the oocytes, the chromosomes are clearly seen, later, they become obscure and are replaced by granules of chromatin.

On Bone Marrow in Hookworm Disease.

WALTER OSWALDO CRUZ (*Men. Inst. Oswaldo Cruz.*, Tome **XXVII**, Fasc. 4, 1933) has described the appearance of bone marrow in cases of infection by *Ancylostoma duodenale* and *Nicator americanus*. The macroscopical appearance of bone marrow from femur diaphysis presented a uniform red colouration as contrasted with the pale tone of other organs of the body due to anæmia and subsequent fatty degeneration. The microscopic structure presented an intense regeneration of parenchyma and a great decrease in fatty cells. The red colouration was due to the great number of erythroblasts laden with hæmoglobin. The author believes that the etiological agent of the hookworm disease does not act directly upon blood causing a destruction through any process whatever, nor upon bone marrow producing an arrest of its regenerative capacity, nor to any paralysing toxic action.

He thinks that the parasite acts upon the iron metabolism causing a quantitative decrease of this element in the organism resulting in an abnormality in the evolution of the normoblast, which is clearly seen in the microscopic preparations of marrow.

Bionomics of Two Estuarine Crabs.

VERY little information is available about the habits and natural history of Indian crabs and Dr. Sunder Lal Hora's note on the Bionomics of two Estuarine Crabs (*Proc. Zool. Soc. London* for 1934, pp. 881–884, pls. i, ii) is, therefore, especially welcome. The note is based on observations of the author made in the field and on simple experiments carried out in the laboratory. The species dealt with, *Varuna litterata* (Fab.) and *Sesarma tetragonum* (Fab.), belong to the family Grapsidæ, several members of which are known to live in estuaries—some have almost established themselves in fresh waters also—under conditions more or less similar to those described by Hora, and are, therefore, accustomed to live for considerable periods out of water. The area from which the author collected his material is also tidal and it would be interesting to know if the crabs are ever left under conditions of complete drought for long periods at any time.

As pointed out by the author, *Sesarma tetragonum* leads an active life, probably with somewhat restricted metabolism, during the "resting period," but it is difficult to say, without further evidence being adduced, if the habits of *Varuna* ever "closely resemble those of an aestivating animal". The crabs found "lying quietly" under dried slabs "with the legs folded beneath the body or spread out wide apart" may have been shamming death, as is commonly done by a large number of animals under similar circumstances; the behaviour of active crabs when placed on dry slabs seems to point to this view.

Dr. Horà's remarks on the burrowing habits of *Sesarma tetragonum* are of interest. Some other species of *Sesarma* and of a few other genera of the Grapsidæ are also

known to burrow deep holes in the somewhat marshy ground on which they live. It is, however, interesting to note at Uttarbhag *Sesarma* burrows in dry ground.

Dr. Hora's observations as also his photographic reproductions are both interesting and instructive and it is to be hoped that he will be able to continue the work he has so well started.

B. N. C.

Studies on the Spermatocyte divisions in Ascaris.

H. P. STURDIVANT makes a significant contribution to the study of the Spermatogenesis of *Ascaris megalocephala* (*Journal of Morphology*, **55**, No. 2, March 5, 1934) in his recent paper on the "Studies of the Spermatogenesis of *A. megalocephala* with special reference to the central bodies, Golgi complex and mitochondria. He describes the centriole of the spermatocytes as a definite entity and its behaviour during the progress of the miotic phase is observed. The disappearance of the centriole in the spermatid and its absence in the later stages are also noticed, and he draws the conclusion that the centrioles of the spermatocytes are not to be regarded as different from the centrioles in the other types of mitoses.

The behaviour of the Golgi complex from the early spermatocyte stage to that of sperm formation is inferred to represent the process similar to that of acrosome formation. Mitochondria which undergo very little change are interpreted as forming the prenebenkern.

Geological Aspects of the North Bihar Earthquake of the 15th January, 1934.†

EARTHQUAKES are due to the fact that the earth is not a dead body, but is subject to continuous, though gradual, change in the shape of its surface due to the uplift and denudation of mountain ranges and the filling up of valleys by silt derived from the higher portions of the globe, and also because of periodic volcanic eruptions relieving the internal heat of the earth. The changes due to mountain building and to deposition are not uniformly distributed over the earth's surface, but tend to be restricted to definite belts known as geosynclinal belts, within which accumulated sediments suffer folding and uplift. One of the principal belts of such folding traverses the Indian Empire in three festoons—the first in the hills of Baluchistan and the North-West Frontier Province, the second along the arc of the Himalayas, and the third along the Assam-Burma arc lying to the west of the Shan plateau. In the Indian Empire it is the tracts contained in, or adjoining these arcs that are particularly liable to earthquakes. The Peninsula towards which these mountain festoons appear to have been pressed by earth forces, is geologically much older and is relatively stable and but little subject to earthquakes.

A statistical study of earthquakes in India was made some years ago, and is contained in a memoir on the "Seismic Phenomena in British India and their connection with its Geology" by Count F. de Montessus de Ballore, published in Vol. XXXV of the *Memoirs of the Geological Survey of India.* To this memoir is attached a map in which the author divides India into seismic regions according to their ralationship to the geology of the country. Since this memoir was published, there have been the following important earthquakes in the Indian Empire:—

* Kangra	4th April, 1905.
* Baluchistan	21st October, 1909.
Maymyo	21st May, 1912.
* Srimangal & E. Bengal	8th July, 1918.
Rangoon	17th December, 1927.
Swa, Burma	8th August, 1929.
* Pegu, Burma	5th May, 1930.
Dhubri, Assam	3rd July, 1930.
Pyu, Burma	3rd-4th December, 1930.
Baluchistan	27th August, 1931.
* Upper Bihar	15th January, 1934.

All these, with the exception of the Maymyo earthquake, belong to the three festoons mentioned, or to adjoining tracts. From this list it will be seen that the Himalayan region had passed through quite a long period of seismic inactivity, the last earthquake associated with the Himalayas

† Sent by Dr. L. L. Fermor, Director, Geological Survey of India, for publication.—*Ed.*

(* denotes very destructive earthquakes.)

being the disastrous earthquake of Kangra in 1905.

The earthquake of the 15th of January, 1934, appears to have been one of the greatest earthquakes on record. For, judging from reports received in the Geological Survey Office, the shock was felt by human beings upto a distance of about 1,000 miles from the probable position of the epicentre somewhere near the frontier between Bihar and Nepal, as records have been received from Peshawar, Multan, Jaisalmer, Deesa, Bombay, Dharwar and Madras. Practically all places from which reports have been received outside this circle have recorded that the earthquake was not felt. The sensitiveness of the observers obviously varies, because from a few places within this circle *nil* reports have been received. To the east and south-east of the epicentral tract the distance to which the shocks were felt by human beings was much less. The shock was felt at Katha in Upper Burma and Akyab, but all places to the east and south-east of an arc joining these two places have returned *nil* reports, so that the distance to which the shock was felt in this direction was about 650 miles only. Evidently the old resistant block of the Peninsula was able to transmit the shock to a greater distance than was possible through the young folded ranges of Assam and Arakan with their less consolidated rocks. We may, perhaps, predict also that to the north in Tibet the shock cannot have been felt to so great a distance as in the Peninsula.

Owing to the frequent inaccuracy of clocks at railway stations, telegraph offices and private houses, it is difficult to obtain an exact record of the time at which the shock originated, and at which it reached the various places where it was felt. Seismograph records have, however, been received from the Alipore, Agra, Kodaikanal, and Colaba Observatories. At the first three observatories, the shock was so intense that the instruments failed to give complete records, so that the only complete seismograph record so far available is for the east-west component as measured at the Colaba Observatory, Bombay. From this it has been calculated that the shock actually occurred at about 14 hrs. 13 min. 22 sec. Indian Standard Time, or 8 hrs. 43 min. 22 sec. Greenwich Mean Time, on the 15th of January, 1934. Assuming the time of origin of the earthquake as calculated from the Colaba records to be correct, one can calculate from the records of the preliminary waves given by Agra, Colaba and Alipore, that the epicentre of the earthquake is situated within a small triangle to the east of Darbhanga, assuming that the speeds of the preliminary and secondary waves of this shock are comparable with the average speeds of most earthquake shocks. This gives an epicentral position some 75 miles to the E. S. E. of Sitamarhi, which suffered the most severe damage of all towns in Upper Bihar. The actual position of the epicentral tract can, however, only be decided from the results of the surveys of the Geological Survey officers at present in the field, and it is not yet possible to say whether the actual epicentre of the shock lies below the alluvium of North Bihar, or whether the shock is due to a movement along the Great Boundary Fault that separates the Himalayas from the Indo-Gangetic alluvium in southern Nepal.* The intensity of the shock at Khatmandu, though severe, was less than at Sitamarhi, but the condition of the less inhabited tracts of south-eastern Nepal has not yet been investigated. It is also impossible yet to say whether the phenomena accompanying this earthquake are to be attributed to one focus only, or whether there are subsidiary local foci.

As the earthquake was felt upto a distance of about 1,000 miles from the epicentral region in North Bihar, the "felt" area of the shock would have been approximately 3,150,000 sq. miles, had the distance of propagation been the same in all directions. Allowing, however, for a shorter distance of propagation to the south-east and probably also to the north in Tibet, it is evident that the recent earthquake is still one of the greatest ever known. For comparison one may mention that according to Davison, a well-known authority on earthquakes, the largest known earthquake is the Charleston earthquake of 1886, which covered about 2,800,000 sq. miles, whilst the "felt" areas for the Assam earthquake of 1897 and the

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* Since this was written, the Geological Survey officers working in Bihar and Nepal have returned from the field and have demarcated the epicentral tract as being 75-80 miles long with an east-south-east alignment through Sitamarhi and Madhubani. This means that the shock is not due to a movement along the Great Boundary Fault, but to some movement below the alluvium of North Bihar. A report by the officers concerned will appear in the *Records of the Geological Survey of India* later in the year.

Kangra earthquake of 1905 were $1\frac{3}{4}$ million sq. miles and 2 million sq. miles respectively.

As to the intensity of the shock of the 15th of January, 1934, data received from officers in the field suggest that the acceleration must have been of the order of 10 to 11 feet per second per second in North Bihar and 8 feet per second per second in Khatmandu. In the great Assam earthquake of 1897 and the Kangra earthquake of 1905, values of 14 and 13 feet per second per second were obtained, whilst in the Pegu earthquake of 1931, values of 4 to 7 feet per second per second were obtained. These figures are of importance as a guide to the engineer and builder in calculating the stresses that buildings may have to stand.

The actual method of propagation of an earthquake shock to a distance is by waves through the surface of the earth's crust and along chords through the crust. Of great importance is the double amplitude of the long or surface wave, that is to say, the distance between crest and trough. This can be calculated from the acceleration just referred to, but as there is some doubt about suitable formulæ, figures for the Bihar earthquake cannot yet be given. It was estimated, however, that in the great Assam earthquake of 1897 the double amplitude of motion was as much as 10 to 12 inches in the most severely damaged tracts.

Whilst the compacted rocks of the Peninsula appear to have transmitted the shock to greater distances than the less compacted rocks of Assam and Burma, yet the earthquake was actually felt more severely on alluvium than on solid rocks. Places in the Brahmaputra valley, for example, further from the actual epicentre than the Shillong plateau, felt the shocks more severely. There appears also to have been reflection of the surface waves by the block of the Peninsula into the alluvial ground at its foot at Monghyr and Jamalpur, explaining the unusually severe damage done in these two towns compared with their distances from the probable epicentre of the earthquake. This is an example of the well-known principle that towns situated on soft alluvial soil suffer much more severely during an earthquake than those built on solid rock, other things being equal. Thus at Tokyo in the 1923 earthquake, it was that part of the city situated on low marshy ground that suffered severely, whilst the higher parts of the city escaped the worst effects.

To the inhabitants of North Bihar, however, the local effects are of much more importance than a general description of the effects of the earthquake. North Bihar is occupied by the Gangetic alluvium, which is of unknown thickness and consists of alternating layers of sand and clay, the sandy layers being full of water. The effect of the earthquake waves passing through this unconsolidated ground was to cause the opening up of fissures and small crater-like vents, up which sand and water from the less consolidated layers were squeezed or squirted to the surface. Reports show that these fissures were upto 20 feet wide though usually much less, and that the thickness of the lenticular layer of sand deposited on the surface ranges down from 3 or more feet close to the fissure to nothing at some distance from the fissure. In some cases these happenings have given us information concerning strata below the surface, for specimens of peat and partly fossilised wood have reached the surface through sand vents and fissures in both Purnea and Champaran. As wells in the alluvium tap the sandy layers for their water content, it is not surprising that a large number of the wells in North Bihar became choked with sand.

As regards other phenomena of the earthquake, the reports received by the Geological Survey indicate that the total duration of the shock was from 3 to 5 minutes, as recorded by a large number of observers upto some hundreds of miles from the epicentre. Many observers recorded the shock as continuous, whilst others mentioned one or more periods of maximum intensity connected by periods of less intensity. Some observers record distinct shocks. Over a very large tract observers reported a rumbling noise sometimes preceding but often simultaneous with the earthquake shock, and this noise is variously compared to the sound of a train entering a tunnel, of motor lorries and of aeroplanes.

The question that has frequently been asked since the earthquake is whether North Bihar is likely in the future to suffer from greater seismic activity than before the shock of the 15th of January, and what is the importance of the aftershocks that are being felt at intervals. A big earthquake takes place because of the accumulation of strains within the earth's crust which are at least in part discharged by the earthquake. The aftershocks indicate that the whole of

the strain was not discharged by the main shock. The general history of earthquakes is that after a severe shock aftershocks occur for a period of months or even years, after which there may be a period of relative quiescence of years. This means that the major portion of the strain has been released, and it is only if the cause which produced the original strains continues to operate causing further strains to accumulate, that another severe shock may be ultimately expected. Unfortunately, geology has no means of predicting whether the occurrence of a big earthquake confers immunity upon the region where it has occurred for a long period of time, though this is the usual position. This means that in rebuilding in areas damaged by earthquakes, engineers should take account of the maximum acceleration hitherto recorded from that earthquake region and arrange accordingly in their buildings.

Micro-Climatology.*

By L. A. Ramdas,
Agricultural Meteorologist, Poona.

Introduction.

IN meteorology we have been concerned in the past with the prediction of weather over comparatively large tracts of country. The large-scale phenomena in the earth's atmosphere extend up to several kilometres above the ground and contribute to what may be called "macro-meteorology". It is usual to consider the surface of the ground and the adjacent air layers upto about 2 metres above ground as disturbing factors. When the meteorologist, however, turns his attention to problems relating to agriculture he finds that it is just this disturbance zone which assumes great importance.

Three years ago, the speaker, in collaboration with a few other workers, undertook a detailed investigation of phenomena taking place in the air layers near the ground.[1, 2, 3] With the creation of the Agricultural Meteorology Branch towards the close of 1932, our studies received a new orientation and the programme of work has included, among other items, also a study of the variation of the micro-climate in different environments, *e.g.*, inside and outside different crops.

In Europe Schmidt, Geiger and others have been studying the micro-climate in temperate latitudes during the past few years and have made numerous important contributions to this new subject.[4]

The International Commission on Agricultural Meteorology at its last meeting at Munich[5] (September 1932) passed several important resolutions emphasising the importance of "micro-climatology" and its investigation in all countries. Similar resolutions were also passed at the Conference of Empire Meteorologists,[6] London, 1929.

The aims of "micro-climatology" are (1) to investigate the physical laws underlying the deviations of "micro-climate" from "macro-climate"; for, a knowledge of these laws is essential for getting a fresh insight into atmospheric phenomena, and (2) to apply the theoretical results to practical ends, *e.g.*, a knowledge of the regular deviations would enable one to predict possible conditions in the hitherto unsurveyed regions with some confidence. In the tropics, owing to the intensive insolation, the "macro-climate" may be expected to be more profoundly modified by variations in the environment than in higher latitudes.

Some of the important aspects of this new subject may now be summarised very briefly. The influence of orography and crops, problems relating to experimental technique, "effective rainfall", etc., will be discussed on a future occasion.

Role of Solar Radiation.

Most variations of atmospheric conditions may be traced ultimately to (*a*) variations in the intensity of solar radiation received at the earth's surface, and (*b*) variations in the disposal of the thermal energy derived by the earth's surface from solar radiation. The first factor varies with season and latitude. The second factor depends on (i) the exchange of heat between the surface of the ground and the layers of the soil which are affected by the diurnal variation of temperature, *i.e.*, the "conduction process", (ii) the exchange of heat between the surface of the ground and the air layers in contact with it or, in other words, the "convective process", (iii) the

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*Report of a lecture on "Micro-Climatology" at the Colloquium, Meteorological Office, Poona, on 10th April 1934.

[1] "Theory of extremely high lapse-rates of temperature very near the ground," by S. L. Malurkar and L. A. Ramdas, *Indian Journal of Physics*, **VI**, Part 6, p. 495.

[2] "Surface convection and variation of temperature near a hot surface," by L. A. Ramdas and S. L. Malurkar, *Indian Journal of Physics*, **VII**, Part 1, page 1.

[3] "The vertical distribution of air temperature near the ground during night," by L. A. Ramdas and S. Atmanathan, *Gerlands Beitrage Zur Geophysik*, **37**, pages 116-17, 1932.

[4] *Handbuch der klimatologie*, Band I, Teil D, "Mikroklima and Pflanzenklima" Von Dr. Rudolph Geiger (1930). Contains an excellent bibliography of micro-climatological papers upto 1930.

[5] Proceedings of the Commission on Agricultural Meteorology; Munich Meeting, publication No. 14, "Secretariat de L'organisation Meteorologique, International."

[6] Resolution No. XIII of the Conference of Empire Meteorologists 1929, Agricultural Section, Report (p. 11, paras 29, 30, 31 and 32).

exchange of thermal energy between the ground surface and the atmosphere by radiation processes, which again are modified by the water vapour and carbon-dioxide content of the atmosphere, and (iv) the heat lost or gained by the earth's surface due to "evaporation" or "condensation" of water at the surface.

Detailed measurements of these complex factors which control what may be called the "thermal balance" at the earth's surface are necessary for a proper understanding of the phenomena taking place in the air layers near the ground and in the first few feet of the soil below. Investigations on these lines are in progress at Poona.

SURFACE CONDITIONS.

The colour of the soil determines the absorbing and the radiating power of the surface. A black surface absorbs most of the incident solar radiation whereas a white surface reflects a considerable fraction of it and is a poor absorber. Recent experiments at Poona show that a very thin coating of chalk over the black cotton soil depresses the maximum temperature by about 15°C. at the surface, 5°C. at a depth of 5 cms., and 3°C. at a depth of 10 cms. At depths of 5 and 10 cms. the minimum temperature also is lowered by about 2°C. These effects penetrate further downwards with rapidly decreasing intensity. The changes take a few days to be fully developed; on removing the chalk the normal conditions are restored gradually and the temperatures become similar to those under the untreated soil only after a few days.

Similarly, even a very thin coating of wet soil at the surface decreases the amount of heat conducted downwards because part of the solar energy received by day is utilized for evaporation. The effects of soil covers of different colours, of a crop cover, and of wetting the surface of the ground, on soil temperatures at various depths are being investigated at Poona.

SOIL CONDUCTIVITY.

The thermal conductivity of the soil is an important factor in controlling the distribution of temperature in the soil as well as in the air above. It varies with different soils and, in the same soil, with the water content. As more and more water replaces the soil air (air is a poor conductor of heat) the conductivity increases; but the specific heat as well as the apparent density also increase so that, beyond a critical stage, the effect of further increasing the moisture content is to depress the thermal diffusivity.

In general, during the day hours a well-conducting soil transmits more heat into the interior, the surface remaining comparatively cool; at night the heat so stored up is returned rapidly to the surface to compensate the radiation loss. In such soils, the diurnal variation of temperature has a small amplitude. In badly conducting soils the heat energy gained by day mostly remains at the surface which becomes very hot and, at night, owing to the radiation loss not being compensated for by heat conducted from below, the surface attains a low temperature. This results in a large diurnal range of temperature in a shallow layer at the surface. The importance of the heat conductivity of the soil in relation to conditions during winter may easily be anticipated. Experiments show that a compact undisturbed soil has a warmer surface at night than one in which the soil has been turned up and loosened at the surface. Reports received from different places on damage to crops due to frost during the cold waves of January last show that crops irrigated prior to the onset of frost were less affected. A study of the thermal conductivity of different soils in varying degrees of packing and of moisture content is therefore of importance.

CONVECTION PROCESS AND RADIATION FROM THE EARTH'S SURFACE AND ADJACENT AIR LAYERS.

During a clear day, the ground surface becomes very warm owing to the absorption of solar radiation; the air in contact with it is warmed up in its turn and is in unstable equilibrium with the denser and cooler air higher up. Consequently, there is a considerable vertical exchange of air mass in the shape of warm ascending currents of air and cool descending currents. This gives rise to the well-known "shimmering". The thermal structure of the "shimmering" layer has been investigated by Geiger[7] and recently ourselves by taking temperature observations with a sensitive thermo-couple set at quick intervals. The vertical interchange of air masses or what may be called "Surface Turbulence" is confined to the first few feet above ground. Above it, is the horizontal flow with its associated turbulence on a larger scale. The effective upward transfer of heat due to both the surface and the free air turbulence is minimum near the ground and, therefore, the ground and the air layers immediately in contact with it attain higher temperatures during afternoons than the air layers higher up.* Owing to the same reason the ground and the air layers near it cool more rapidly by night than the layers higher up. This results in a large diurnal range of temperature near the ground, the range rapidly decreasing with height. As may be expected in the higher latitudes, the frequency of frost is found to decrease with height. In tropical countries, however, owing to the fact that even during the night the ground is warmer than the cooling air above,[8] it may be expected that the height of maximum frost frequency will be a few inches above the ground. This is also supported by recent frost reports.

The conditions that prevail at night are equally interesting. Soon after sunset the ground and the air layers above it begin to cool rapidly by radiation. The air layers begin to stratify, *e.g.*, at Poona it is observed that the cooling of the air by radiation in winter is of the order of 10°C. per hour during the first half hour after sunset, the fall of temperature being large near the ground and decreasing with altitude. Occasionally, winds of local origin set in for short periods during the night; then the stratification is disturbed temporarily, the air layers get mixed up and there is a rise of temperature as a result. Towards the end of winter, the sea breeze sets in in the evenings and continues for a few hours during the night.

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[7] Page D. 26 of publication (4) above.

*Temperature and humidity observations taken at several heights above ground, both above bare soil as well as inside a few representative crops at the epochs of maximum and minimum temperatures, are being discussed by the writer and others in a series of papers. Each crop is found to develop its own peculiar local climate, the deviations of which from the "open" depend upon the season and the growth of the crops.

[8] Ramdas and Atmanathan, *loc. cit.*

During such nights the convection and the radiation processes act simultaneously and bring about a more gradual and less accentuated fall of temperature than during calm winter nights.

WIND MOVEMENTS.

The complex thermal structure referred to in the above section has also its counterpart in the wind movements in the air layers near the ground. Simultaneous observations of wind velocity taken at various heights show considerable variations, the larger variations being associated with greater turbulence. It is found that there are three zones *viz.*, (*a*) one near the ground in which the surface disturbances predominate, (*b*) an intermediate layer in which the air is relatively quiet, and (*c*) the regions above where air movement is more or less horizontal and where the large-scale turbulence investigated by G. I. Taylor and others prevail. Schmidt's[9] observations also show that the surface turbulence increases with the roughness of the surface, *e.g.*, over a turnip field the variations in the wind movements are larger than over a bare plot.

LIMITS OF SURFACE CLIMATE.

The change from the surface to the climate of open space is not quite gradual. R. Geiger[10] quotes evidence to show that there is a level of transition at about $1\frac{1}{2}$ to 2 metres above ground which would probably coincide with the quiet zone referred to in the previous section. In tropical regions it may be expected that, owing to the more intense insolation, the horizontal partition between the zone of vertical exchange and the zone of horizontal flow may be slightly higher up. Recent observations appear to show that this upper limit of the surface climate undergoes variation during the day, attaining a maximum height in the afternoon and coming down towards the ground in the evening and later during the night. Observations of the temperature distribution at short intervals of height and time after sunset indicate the rapid fall of this level which may be expected to coincide also with the level at which the nocturnal inversion of temperature begins. In short, the surface turbulence will not completely die away in the tropics even during winter nights owing to the greater warmth near the ground. In higher latitudes, owing to the weaker solar insolation, the surface turbulence will cease after sunset and the inversion of temperature may start at the ground surface itself.

THE WATER VAPOUR CONTENT IN THE ATMOSPHERE.

During all seasons of the year there is a considerable amount of evaporation of water from the soil surface. During the wet seasons it may be expected that the specific humidity in the air would be more or less constant with height above ground, with a tendency to be a maximum near the ground during periods of sunshine. At Poona, the above state of affairs prevail during the monsoon season, *i.e.*, June to September. During autumn, the upper layers of the soil rapidly desiccate and, by the time winter sets in, the loss by evaporation during day becomes smaller. It is still found that the usual decrease of vapour pressure with height persists even during this period. A surprising observation is that during night the above situation is reversed, *i.e.*, water vapour is minimum near the ground and rapidly increases with height. It was somewhat difficult to explain this at first sight, but, measurements of the loss of water from samples of soil exposed under natural conditions at the surface of the ground during the day showed that the loss is actually compensated by the absorption of moisture from the air by the same samples during the night. In other words, the soil which is intensively desiccated during the day acts as an absorber during the night thereby producing a minimum of vapour pressure near the ground. These results will be discussed more fully elsewhere.

EVAPORATION.

The evaporating power of the atmosphere is measured by the loss of water in small reservoirs with suitable measuring devices. As a meteorological element evaporation expresses the combined influence of temperature, humidity, sunshine, etc., as a single factor. Recent observations at Poona with a series of Piche's evaporimeters at various heights show that upto 4 ft. the evaporation increases with height even during the afternoon when the ground surface has the highest temperature. The effect of wind is thus seen to be more pronounced than that of the high temperatures near the ground. The study of the variations of evaporation in different environments at the same place, as well as the standardization of different types of evaporimeters are in progress.

DEW FALL.

When objects thermally insolated from the ground lose more heat than they gain from the air in their neighbourhood, their surfaces attain a lower temperature than the air. This results in condensation of water vapour if the lowering of temperature is sufficiently large. In many parts of India dew deposition during the night is very pronounced during clear weather. Exact measurements of dew deposition are not available at present, but qualitative observations at Poona made with collectors with bright surfaces exposed at various heights during last winter show that dew deposition starts from a height of 6″ to 1 ft. above bare ground and increases with height.

[9] Page D. 28 of (4).

[10] Page D. 31-34 of (4).

Science News.

Andhra University Employment Bureau:—According to a notification of the Registrar of the Andhra University, an employment bureau whose object is to advise and guide the unemployed graduates and undergraduates of the University in the matter of securing employment, has been started. Graduates and undergraduates of the University desirous of availing themselves of the services of the bureau should correspond with the Registrar.

* * *

Seventh International Congress on Industrial Accidents and Diseases, 1935:—The Congress will be held in mid July 1935 at Brussels. The Congress will be divided into 2 sections representing the International Congress on Industrial Accidents and the similar Congress on Labour Medicine, both meeting together.

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Rao Bahadur L. K. Ananthakrishna Iyer, one of the leading anthropologists of India, sailed for Europe on 23rd April on a few months' tour. Prof. Iyer, who is now 72 years' old, has been invited to deliver lectures on Indian Anthropology by various universities in Britain and on the Continent. He will represent India at the International Congress of Anthropological and Ethnological Sciences which will meet in London towards the end of July.

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The Government of India have awarded the Central State Scholarship to Mr. Balwant Singh Anand, M.A., of Baluchistan to enable him to study for English Tripos at Oxford or Cambridge.

* * *

Nanga Parbat Expedition:—The second German attempt to climb some of the unconquered peaks of the Himalayas including the famous Nanga Parbat has arrived in India. It will be recalled that the first attempt to reach Kinchunganga was made four years ago and proved unsuccessful. Herr. Willy Merke is the leader of the expedition consisting of thirteen other members. Their ban camp would be at the foot of the Rakeit glazier which they hope to reach by the end of May. It is expected that the climbing of the Parbat would take them about two months.

* * *

Vice-Chancellor of the Madras University:—Mr. R. Littlehailes has been appointed Vice-Chancellor of the Madras University.

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Imperial Council of Agriculture:—The Council will start a marketing section for which the Government of India will give an annual subsidy of Rs. 1,00,000 for a period of three years. Mr. Livingstone of the British Marketing Board has been appointed Marketing Officer and he is expected to join duty early. In co-operation with the provincial marketing officers and in consultation with the trade, it is proposed to arrive at a national grade of standards for such commodities as wheat, rice and oil-seeds. It is also proposed to organise marketing surveys. The possibility of establishing 'exchanges' at the principal wholesale markets including arrangements for arbitration on quality based on accepted national standards will also be examined by the officer.

* * *

Dry Farming Research:—The Imperial Council of Agricultural Research has sanctioned a sum of Rs.1,40,000 for subsidising research on Dry Farming at the Hagari Agricultural Station. A good portion of the aided districts constitutes a famine zone with a poor rainfall of capricious distribution. The scheme which is of a utilitarian character allows of the investigations in the laboratory and the field of the relation of soil moisture to crop growth, and methods of increasing the availability of moisture. It is also proposed to investigate the water requirements of the important crops of the tract, *viz.*, sorghum, Italian millet and cotton.

* * *

Jute Research in India:—The Committee of the Indian Jute Mills Association have decided to invite Dr. S. G. Barker, Director of Research of the Wool Industry Research Association, Leeds, to visit India in the near future to study the position of the Jute Industry in India and formulate a research scheme to suit the industry's requirements.

* * *

Institution of Engineers, Viceroy's Prize:—The Council of the Institute of Engineers (India) has awarded the Viceroy's Prize of Rs. 500 for the year 1932-33 to Mr. S. Kamesam, B.E., M.E., A.M.I.E., Officer-in-Charge, Wood Preservation Section, Forest Research Institute, Dehra Dun, for the paper on "A New Principle in Wood Preservative Impregnation Technique and its application with special reference to chir, *Pinus longifolia*" for railway sleepers.

* * *

Pasteur Institute of India, Kasauli:—The thirty-second annual report of the Institute, recently issued, records several important advances achieved in the treatment of rabies. As a result of researches covering a long period, it has been shown that large doses of vaccine were superior to small doses in preventing rabies and that the Paris strain of rabies fixed virus was superior to the Indian strain in antigenic value. To give practical application to these results during 1932, the Paris virus alone was used in manufacturing vaccine, and a higher average dose was administered than had previously been in use. As a result of these measures the total number of deaths was 27 per cent. less than in any previous year. The percentage of death rate was as low as 0·57.

* * *

Campaign against Locust Pest:—Consequent to his discovery that adult locusts and particularly those on the wing fell speedy victims to a spray of finely ground sodium arsenite, Mr. H. H. King, formerly chief entomologist to the Sudan Government, will soon start a mass attack on locust swarms in northern Rhodesia. The experiment will be watched with great interest, particularly because the usual methods of combating locusts are mostly confined to their egg and hopper stages but so far no method of tackling the locusts in the winged stage is available. The problem is of interest to India and if Mr. King's experiment proves successful and safe a great advance would have been achieved in our methods

of combating this ancient enemy of the agriculturist. Mr. King's plan of campaign is to fly to and fro across the line of advance of the swarms of locusts and fill the air with fine poison dust discharged from special blowers mounted on the wings of the machines. In view of the fact that the natural dissipation of the cloud reduces in a short time the density of the poison dust to a point when its effects are no longer poisonous, it is unlikely that any danger will arise to human beings, crops and livestock.

* * *

Archæological Commissioner for Ceylon:—The *Ceylon Gazette* invites applications for the post of Archæological Commissioner in Ceylon on a five-year contract on Rs. 12,000 rising to Rs. 15,000 per annum.

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Dr. S. L. Hora describes a few sedentary games of India in a recent number of the *Journal and Proceedings of the Asiatic Society of Bengal*, **29,** No. 1, 1933. Indian traditional history has a large number of indigenous games, of which a few are described in the paper. Most of these have become extinct except in a few out-of-the-way places in the country, which have not come under the influence of Western culture and where the games of the West have not penetrated. While Carrom, Cards and a few other sedentary games are Western invasions, the Indian labourer had, for the delectation of the long rainy evenings, a number of very interesting games which demanded a fair amount of skill and thought. Of these *Bhagchal*, *Lam Pusri*, *Lam Turki* and *Gol-ekuish* are described by the author. Chess is probably our only still popular survival of the olden days.

* * *

Lemuria—the lost continent:—Indian geologists have long been familiar with the evidences in favour of the existence of an extensive southern continent known as the Lemuria during the Mesozoic era. Chiefly on the basis of palæontological studies of the Mesozoic rocks in the now widely separated areas like India, Africa, Australia and South America, geologists have concluded that in those remote times, an unbroken and continuous land connection existed between these distant regions across what is now the Indian Ocean and the Arabian Sea. While this conclusion has been generally recognised, there has been a difference of opinion among geologists regarding the way in which this continent broke up and led to the modern conditions of distribution of land and water. The older idea has been that this land area broke up as a result of the submergence of large portions underneath the sea; in other words, that the breaking up was effected by the foundering or sinking of the intervening portions of the continent. More recently several geologists who have been impressed by Wegener's theory of Continental Drift seek to explain the breaking up of the Lemurian continent in accordance with this theory, and postulate that the existing continents were grouped together during the Carboniferous period as one continuous land mass in apposition to South Africa and that subsequently, this continuous land mass was fractured, with drifting apart of the fragments to form the present continents. There has been considerable discussion regarding the relative merits of these two hypotheses, and it has now been recognised that the final solution of this problem must await further researches. Speaking on this subject in his presidential address to the Indian Science Congress at Patna in January 1933, Dr. Fermor referred to the forthcoming Murray Expedition led by Col. Seymour-Sewell and said that, if during this expedition rock specimens in any quantity can be secured from the bottom of the ocean, we would get some "evidence helpful to the determination of whether India has been separated from Africa by the foundering of the intervening land or by drifting apart."

In the light of this, it is very gratifying to read the announcement made in the press only a few days back that this expedition has been able to collect extensive samples of rock material from depths of 2-5 miles below the surface in both the Indian Ocean and the Arabian Sea. It is expected that an intensive study of this material, which will shortly be undertaken at Cambridge, will make it possible to draw the map of a large part of the world as it existed millions of years ago in the days of the Lemurian continent. One of the important achievements of the Expedition is the discovery of "a submarine mountain range rising 10,000 feet from the ocean floor, whose summit is yet 1,000 feet below the surface between Socotra and Sychelles." So far as the breaking up of the Lemurian continent is concerned, the observations recorded during this Expedition seem definitely to support the older idea of the foundering of the land masses as against the theory of continental drift. Geologists all over India, will be eagerly looking forward to a fuller and more comprehensive account of the results of the Expedition, which will no doubt be published in the near future.

* * *

Ring-Dykes in India:—Subsequent to the publication of the note in *Current Science* (**2**, No. 7, p. 246) on the occurrence of a ring-dyke near Hulikere, Mandya Taluk, by Mr. M. R. Krishnamurthi Rao and others wherein the authors had claimed that this ring-dyke was the second example of its kind in India, Mr. A. L. Coulson of the Geological Survey of India has written to us drawing attention to the occurrence of another ring-dyke which he has described from Mundwara in Sirohi State, Rajaputana.

* * *

New Drying Agent:—The first technical paper concerning a new drying agent prepared in the form of anhydrous calcium sulphate appeared in the June and October issues of *Industrial and Engineering Chemistry*. The desiccant is efficient, versatile, inexpensive, regenerative, neutral, inert and insoluble in organic liquids and can be prepared in the form of powder or granules of any desired size. A number of laboratories, interested, have made trials with this new desiccant, and it will soon be produced on a commercial scale.

* * *

Chemical Age Year Book, 1934:—The latest publication of this highly useful book (published in January 1934) is bigger than usual and contains revised and extended tables of data and notes invaluable to the practising chemist. Some outstanding events of the year, names and formulæ of common chemical compounds, physico-chemical tables, main provisions of the Pharmacy and Poisons Act, 1933, are only a few of the more important items besides the Diary chosen from the contents of this chemist's companion. We

heartily recommend this publication to every chemist.

* * *

*Fish slime and precipitation of suspended mud in water.** S. L. HORA.—The slipperiness of the body of a fish is due to the presence of a slimy mucus secreted by special skin glands. The function of the slime is supposed to be "to minimise friction with the surrounding water and to enable the fish to glide along easily". While investigating the biology of *Lepidosiren*, a lung-fish of South America, Prof. J. Graham Kerr found that the "mucous secretion of the skin of *Lepidosiren* appears to have a remarkable power of precipitating mud held in suspension in water". In connection with my work on the ecology of certain estuarine fishes Prof. Graham Kerr suggested to me to test whether the slime of these fishes reacts similarly to that of *Lepidosiren*. Water in which fishes had been kept for some time was used for testing this property, and it was found that this 'slime-solution' had remarkable power of precipitating mud held in suspension. A successful demonstration of the actual process was given in the meeting by using the slime of *Ophichthys boro* (Ham. Buch.) which precipitated the mud within about a minute.

Investigations have been started for testing the slime in the case of several other clear-water and muddy-water fishes.

There appears to be a special biological significance of this phenomenon. "Water-breathing" fishes are usually suffocated in muddy water, and in several parts of India advantage is taken of this fact for fishing purposes. By the precipitation of the mud with the help of the mucus the water-breathing fishes are able to have clear water for respiration by means of their gills, which, it may be remarked, are very delicate structures, and likely to be choked with mud in dirty water.

* * *

University of Madras.—Applications are invited for the post of a Lecturer in Statistics, the salary of which is Rs. 210—15 (annual)—300 per mensem.

The appointment will be in the first instance for a period of three years and subject to confirmation thereafter.

The Lecturer will be required to deliver lectures, conduct classes (Diploma in Economics or any other special classes) and to engage in research and to assist in any other academical work relating to the departments of the University which may require his services.

The selected candidate will be required to enter into an agreement with the University according to the laws (*vide* Chapter VIII, Cal. Vol. I, Part I) and should join the appointment within a fortnight after the receipt of the order of appointment.

Applicants for the post are requested to forward their applications (9 copies) containing full particulars as to age, nationality, present position and salary, academic and other qualifications, teaching and research experience in general and in the subject, if any, research work or publications in the subject, together with copies of recent testimonials and names of two persons to whom a reference can be made. Applications should be addressed to the Registrar, University of Madras, Triplicane P.O., Madras, and should be marked on the envelope, "Application for the post of Lecturer in Statistics" and should be sent so as to reach the Registrar on or before the 29th June 1934.

Canvassing by applicants will be viewed with disfavour.

* Abstract of a communication made at the March 1934 Meeting of the Asiatic Society of Bengal.

* * *

Sir S. Radhakrishnan, Vice-Chancellor of the Andhra University, will be leaving India on 21st June 1934 to attend the meetings from the 16th July 1934 of the International Committee of Intellectual Co-operation of the League of Nations which will be held at Geneva. The Syndicate of the Andhra University at a meeting held on the 15th May 1934 appointed Rao Bahadur Dr. T. S. Tirumurti to act as Vice-Chancellor for nine weeks during the absence of Sir S. Radhakrishnan.

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The Crop-Planning Conference called by the Government of India will assemble at Simla on June 8, 1934. It is understood that the object of the Conference is the adjustment of the production of agricultural produce to demand.

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At the Ninth Congress of Pure and Applied Chemistry which opened in Madrid on April 5, Prof. H. E. Armstrong and Prof. R. Robinson, Waynflete Professor of Chemistry at Oxford University, received the degree of Doctor *Honoris Causa*.

* * *

Applications invited:—(1) Professor of Electrical Technology, salary Rs. 1,000-50-1,250 with an overseas allowance of Rs. 250 per month. Applications should reach the Director, Indian Institute of Science, Bangalore, India, not later than 1st August 1934. (2) Senior Botanical Assistant, salary Rs. 250-25-375 per mensem subject to an emergency cut of Rs. 5% p.m. Applications must reach the Director, Institute of Plant Industry, Indore, C.I., not later than 15th July 1934.

* * *

We acknowledge with thanks the receipt of the following:—

"Nature," Vol. 133, Nos. 3359 to 3362.
"The Chemical Age," Vol. 30, Nos. 768 to 771.
"Canadian Journal of Research," Vol. 10, No. 2.
"The Biochemical Journal," Vol. 28, No. 1.
"Natural History," Vol. 34, No. 2.
"Journal of Agricultural Research," Vol. 47, Nos. 11 and 12, and Vol. 48, Nos. 1 and 2.
"Journal de Chemie Physique," Vol. 31, No. 3.
"Science Progress," Vol. 28, No. 112.
"The Review of Scientific Instruments," Vol. 5, No. 3.
"Scientific Indian," Vol. 11, No. 64.
"Medico-Surgical Suggestions," Vol. 4, No. 4.
"Bulletin of the Patna Science College Philosophical Society," No. 4, January 1934.
"Forschungen Und Fortschritte," Jahrgang 10, Nos. 9 and 10.
"The Indian Journal of Agricultural Science," Vol. 4, No. 1.
"The Indian Trade Journal," Vol. CXII, No. 1449 and Vol. CXIII, Nos. 1451 to 1453.
"India Meteorological Department—Scientific Notes," Vol. 5, Nos. 56 and 57.
"Actualites Scientifiques et Industrielles," Nos. 81 to 88.
"The Journal of the Annamalai University," Vol. 3, No. 1.
"The Journal of the Indian Mathematical Society," Vol. 1, No. 1.

Reviews.

THE PLACE OF MINDS IN THE WORLD. Gifford Lectures. (Aberdeen, 1924-26.) By Sir William Mitchell, K.C.M.G. (Macmillan & Co., London. Pp. 374.) 12*s*. 6*d*.

When Bertrand Russell's little book entitled 'Problems of Philosophy' appeared two decades ago, F. H. Bradley remarked 'as if there are any problems in philosophy'. The suggestion is that in philosophy there is only one problem and that its solution cannot be advanced by the method of detached analysis of isolated themes. Anyway, after some thirty years of analysis, we seem to be in a more synthetic mood at the present time. The large speculative horizons of recent physics offer an invitation to philosophy to weave her web afresh in a larger and more inclusive pattern. Much of modern philosophy centres in the place of minds in the world, the theme of the Gifford Lectures of Sir William Mitchell. Indeed the status of mind in the universe may be said to be the water-shed of modern philosophy, ever since Descartes launched its career on the tough little boat of 'self-consciousness'. All current varieties of idealism and realism, vitalism and materialism spring from different attitudes to this problem. All forms of idealism assign a determining rôle to mind, individual or cosmic. If finite centres of mental life appear at a late stage of the universal drama, they contend that it is because the central core of reality itself consists of consciousness which sends forth its "flashes of uncreated light" when the theatre is ready. Pure idealism goes the length of resolving all things into mind. To it even matter is mind, it may be of a lowly order. Professor Eddington is the most eloquent contemporary exponent of this ancient panpsychism. Among historical types, Berkeleyanism is the most completely worked out form of this view. Platonism, represented in modern times by many varieties of Hegelianism, admits the reality of matter or something other than mind or spirit but assigns a subordinate place to it. According to this theory, matter by which the philosophers mean anything the results of science may reveal, is a condition that emerges in the activity of self-realisation into which ultimate reality is perpetually flowing. This school upholds therefore not the utter self-sufficiency but the supremacy of mind. And realism in all its forms challenges this enthroning of mind. It makes determined attempts to show mind its place as a feeble and late arrival and a sort of Cinderella among the forces and entities that make up the world. Every attack and defence, sally and repulse in this complex and many-sided debate is represented in the history of Indian thought in the past. Advaita Vedanta may be said to correspond to pure idealism or spiritualistic monism reducing all things to one universal expanse of consciousness. Dvaita and Visishtadvaita align themselves with concrete or objective idealism recognising a dependent but distinct place for a reality other than mind or spirit. The Nyaya-Vaiseshika is Indian realism *par excellence*, with its realist epistemology and atomic cosmology. There is a renewed attempt at the present time 'to save the appearances' in Plato's phrase or in Alexander's words 'to order mind and objects to their proper places in the scheme of things' and this series of Gifford Lectures is a notable contribution in this direction.

The book under review is the first of the series; the second seems to be reserved for the power of minds. One would have thought that the place of a thing cannot be truly determined apart from a consideration of its power of function in its milieu. Indeed this is the essential spirit and aim of the author's treatment. It is an elaborate attempt to show that mind is what it does and is not to be thought of as a self-subsistent entity 'in the skull' in accordance with the 'natural metaphysic of the human mind'. But one cannot say all things at once and perhaps we have here just enough of the function of mind in knowing as exemplified in the systematic activity of science and scientific world-building to indicate the locus and status of mind *vis-a-vis* the object of knowledge. The modern world is haunted by the fear of subjectivity. There has been a magnificent growth of knowledge in the past three centuries, but the interpretation of its final outcome is not clear and unequivocal. The inspiration that should have flowed from the realms of order that the various sciences have disentangled from the total matrix of experience and Nature has been stifled by certain clogging notions, the outcome of a naive common sense theory and a disabling philosophic tradition. Common sense may be sound in its instincts but common sense theory or *prima facie*

philosophy has been the source of much mischief in the history of thought. Common sense believes that it knows things as they are, but when it reflects that it requires eyes to see and light rays to convey the message from the object to the brain, it rushes to the conclusion that the object causes an impression in the mind and that all knowledge consists in a contemplation of these peripherally excited images or copies of external things. And when this common sense theory was enshrined in the philosophies of Descartes and Locke the ghost of subjectivity was born, which has not yet been laid, in spite of repeated attempts. It is a most disabling thing to realise that, do what we can, we can never get away from ourselves and penetrate into the objective universe as it really is. The world is sundered into phenomena and noumena, appearance and reality, secondary and primary qualities, perceptual objects and scientific objects and so on. Knowledge is stultifield in its source and the creative faith that is the fountain-head of scientific inspiration, the austere endeavour to catch the object in its pristine purity untouched by the shadow of the self, are likely to be paralysed. It is not for nothing that Max Planck has been obliged to go out of his way to affirm his conviction of the objectivity and extra-mental character of the physical world. Whitehead protested against this bifurcation of nature in his earlier works but the fissure reappears in his later metaphysical works *Symbolism* and *Process and Reality*. And it is a question whether Mitchell also does not concede too much.

Mitchell's way out of the impasse is by distinguishing mental functioning into levels so that they may read naturally as an expanding causal system on the analogy of the physical structure,—fact, law and causal system. The 'royal road' from surface to depth is similar in both cases. The gulfs and doubling usually resorted to as regards the relation of mind and body and mind and object are the results of a wrong point of view and a wrong expectation. We stop at analogy with common sense explanation in the sense of familiarisation in terms of minuter but similar units and fail to follow the suggestion of fact to the natural conclusion. Instead of following the living line which opens out into a system of operations we think of mind as a self-enclosed entity and look for its essence inside the brain! This is in our author's terminology to confound the living and the correlation lines. The brain is a condition of the mind's activity but a condition does not hold the secret of anything. What then is the locus of mind? Mitchell answers—wherever it functions. Well, the mind plays upon all things in heaven and earth. According to Mitchell, it is wherever it goes. In Indian terminology it appears whenever things are illuminated by it. This reminds us of the Advaitic theory of the self that it is infinite in its nature coincident with universal consciousness. Of course the modern term mind has to do duty both for the Atman or Sakshi and for Manas or Antahkarana. In his anxiety to free the notion of mind from materialistic implications, Mitchell pays no attention to the other equally important aspect of the idea, *viz.*, the individual uniqueness or centrality of minds. Minds may go everywhere but they move from somewhere. They have a unique association with certain localised bits of space-time-material called bodies. Both reference to object and unique loci are essential constituents of minds. The very notion of *minds* in the plural would otherwise be inexplicable. Some forms of Idealism hold that the body is enough to be the centre of consciousness so that all differences between experiencers are only incident to their embodiment. Bosanquet is the most prominent exponent of this view in current literature. Advaita Vedanta holds a similar view. The one universal consciousness according to Advaita refracts itself into myriad selves owing to upadhis or limiting adjuncts. Lotze Pringle-Pattison and others oppose this theory and insist that finite individuality requires a central essence, a focal point, other than the material embodiment. Location in space-time-material can only be a condition of manifestation for a reality already there but cannot bring into existence what never was there. The Dvaita and Visishtadvaita schools represent this type of thought. They urge that the soul is atomic as centre of action but *vyapta* or all-pervasive in range of function and influence. Both the centre and the horizon are therefore to be duly included in any adequate theory of mind. Though this aspect of the problem is not dealt with in this volume (it may be reserved for later treatment) the principle and method of Mitchell's exposition is sound and fruitful, as indicated by the fact that the view of mind as a system opens out into expanding horizons taking in all the results of analysis in a

natural way. But though the method is sound it cannot be said that the full possibility inherent in it is worked out or even suggested. One who sets out to show mind as a growing system may be expected to take into consideration the larger views dominating the current schools of psychology, Hormism, Gestalt, Psycho-analysis, and Behaviourism and exhibit the levels of mind in action as it were. One misses concrete detail in the development of the theme. But the point of view is clear and is in the direct line of Platonism and Hegelianism and recalls Bosanquet's fine fragment 'Three Chapters on the Nature of Mind'. The opposite way is exemplified in the work of Bertrand Russell—*The Analysis of Mind*, in which he tries to build up what may be called a 'chemical view' of mind with the self-subsistent bricks of sensation and image. Powder the mind and think of its constituents as motes in a sunbeam—this is the way of Russell. It is clear that much depends upon the orientation of the thinker in these matters. If one has in view the higher spiritual values as embodied in the concrete achievements of human nature, art, religion, society and so on, one is likely to stress what may be called Platonic approach. Similarly, logical atomism springs usually though not necessarily from a mathematical and physical background.

A special feature of the treatment of Mitchell consists in the elaborate analogy between the mental and the physical structures. Fully half the book is taken up with the history and evolution of the fundamental concepts formative of the scientific outlook from Newton to Einstein and Planck. Throughout he traces the changing notions of matter and space and time and points the moral for a true interpretation of mind. Every crisis has involved a mistaken metaphor and has opened out when its restrictions were removed by a larger idea. In effect this part of the book seems an effective commentary on the dictum of Whitehead (though perhaps it was written earlier) that "all constructive thought, on the various special topics of scientific interest, is dominated by some such scheme unacknowledged but no less influential in guiding the imagination" (*Process and Reality*, Preface). Further, Mitchell makes use of the course of scientific thought to show that theory is no copy of reality but is a system of symbols pointing at objects. As the surface need not resemble the depth, the symbol need not imitate the symbolised. Though he sets himself strenuously against all theories of 'psychic additions' and bifurcation of nature, one is left with the uneasy suspicion that he has conceded too much for the phenomenalist. Adapting the phrase of Mach that nature is a system of phenomena he follows out the implication of the notion of system which heals up the gulf with which the idea begins. But he seems to hold that phenomena in the sense of sensory appearance is coeval with the rise of organisms with the requisite apparatus. Phenomena and human minds rise together. Prior to the appearance of man upon the familiar world, colour and sound, etc., did not exist. But this gives up the case for objectivity at a crucial point. Relativity to the human organism and powers need not mean subjectivity at all. As Alexander would put it, we and our apparatus are only instrumental in selecting and focussing, and not in creating any part of our environment. On any other view, the 'old man of idealism' (by which he means the self-stultifying type of subjective idealism) is inescapable. A selective theory is in current thought associated with realism, but a thorough-going ontological idealism of a concrete variety may be built on its basis. The Indian theories of mind as illuminators or mirrors will be very suggestive in that direction. Mind will be a diaphanous presence with a centre but a potentially universal range, a power inherent in things that does not add to or take away from the material system, but only reveals it in greater or less degrees. As Bosanquet put it, mind may be usefully thought of as a power which exhibits itself at different levels like the ebb and flow of the tide. Anyway, the combination of science and philosophy exemplified in this book is rare and reminds one of Emile Meyerson's *Identity and Reality* and of Whitehead's *Science and the Modern World.*

Any adequate consideration of this book must wait for the publication of the second series. But the attentive reader can guess that the rôle that Mitchell is finally going to assign minds is likely to be nearer that of Plato and Hegel than that of Alexander or Whitehead. If 'nature takes up space and time,' 'if units are unities,' 'if nature is what it grows into,' 'if wave and particle are inseparable,' and their disjunction a legacy of commonsense metaphysic, one may safely hazard the prophecy that the full system

that Sir William Mitchell has up his sleeve is an original variant of organic spiritual idealism.

M. A. VENKATA RAO.

* * *

ESSAYS IN PERSUASION. By John Maynard Keynes. (Macmillan & Co., St. Martin's Street, London. Pp. xiii+376. 1933.) Price 5*s*. net.

"The Essays in Persuasion" of J. M. Keynes, the world-famous British Economist, are a collection of essays "taken out of the author's printed writings, whether books, or pamphlets or newspaper or Magazine articles." The book is divided into five parts, the first three of which, the Treaty of Peace and the War Debts, the Policy of Deflation and the Return to the Gold Standard, are closely inter-connected and were written by the author in the course of the last decade and a half "to convince his audience in time". The essays might have been more appropriately called, as the author himself says, "Essays in Prophecy and Persuasion" "for the prophecy, unfortunately, has been more successful than the persuasion." They are brilliantly written, and when we realise how true the prophecy has turned out to be, our sorrow is all the greater that the warnings were not heeded to in time.

The first part is a brief résume of the author's views on the Treaty of Versailles of 1919, contained in his two books: the *Economic Consequences of the Peace* (1919) and the *Revision of the Treaty* (1921). Here the author points out most beautifully how impossible it was for Germany to pay the huge war indemnity imposed on her by the Allies. If Germany was responsible for the huge losses inflicted in the world in the course of the war, the French and British spokesmen who inflicted on Germany an impossible peace, completed "The ruin which Germany began". The European statesmen, urged by their vindictive spirit, abused their momentary victory to destroy Germany and Austria-Hungary, forgetting that thereby they were inviting their own destruction also, as the economic bonds of Europe are deeply intertwined.

The author first estimates the capacity of Germany to pay. By examining her exports and imports for the five years preceding the war and her annual production of surplus wealth, the author comes to the conclusion, that the loss of her territory, her foreign investments, her ships and her foreign banking, the burden of her debts, the reduced productivity of her soil from lack of manure and of labour, would leave Germany with a favourable annual trade balance of only £ 50 m. calculated in pre-war prices, or at £ 100 m. allowing for the rise in prices of the post-war period. This sum could be capitalised at the present value (1919) of £ 1,700 m. or roughly at £ 2,000 m. Germany surrendered property valued at £ 500 m. at the time of the armistice and the remaining £ 1,500 m. should be paid by Germany in 30 annual instalments without any interest. But the Allies imposed on her a burden of £ 10,000 m. "The policy of reducing Germany to servitude for a generation, of degrading the lives of millions of human beings and of depriving a whole nation of happiness, should be abhorrent and detestable, even if it were possible."

But Reparations were closely involved with inter-allied indebtedness. In the course of the war, England borrowed from the U.S.A. £ 850 m. and during the same time, lent the Allies £ 750 m. so that the loans were more for financing the Allies rather than for England herself. The British Government have been pressing from the very beginning that the inter-ally indebtedness was not in the nature of an investment and should be entirely cancelled. In 1922, in the Balfour note, the British Government expressed their willingness to cancel the whole of what the Allies owed them and also to surrender their whole claims on Germany, if the U.S.A. would relieve them of their debt. This policy was not accepted by the U.S.A. but the Allies felt that the question of granting relief to Germany was intimately bound up with the question of their indebtedness to the U.S.A. though the U.S.A. refused to see any connection between the two. But if the Allies were to pay huge indemnities to the U.S.A. without full compensation from Germany "they may be expected to make constant attempts to evade or escape payment". The author therefore advised all the States to make a "general bonfire of all these paper shackles".

The second and the third books are the most instructive. The author quotes with approval a saying of Lenin that the best way to destroy the capitalist system was to debauch the currency. If Governments followed the policy of Inflation for a long time, they can confiscate, secretly and unobserved, a very great part of the wealth of their citizens. During the course of the war from 1914 to 1920, many countries

adopted the policy of Inflation and since 1920, the same countries went through a period of Deflation and contracted their currency. The policy of Inflation which accompanied and followed the war, reduced the real value of the savings of the people to one-half in England, to $\frac{1}{5}$ in France, to 1/12 in Italy and to nothing in Germany, Austria, Hungary and Russia. But the period of rising prices stimulated production and benefited the businessmen and the working classes.

But when Deflation began, prices began to fall and unemployment succeeded prosperity. In April 1929 there were 1,140,000 unemployed in England; in 1930, 10 millions were unemployed in the U.S.A., Great Britain and Germany and in 1932 the number increased to 12 millions. During all these years no important industry was making enough profit to expand. The primary products were, and are selling, at a price which do not cover their cost of production; and the consequent restriction in the production of the primary products had a further adverse reaction on manufactures, as the purchasing powers of the primary producers were still further reduced. Every fall of prices increases the burden of the national debt. The catastrophic fall in prices ruined millions of farmers. "When incomes are falling, there is no use of goods becoming cheap; cheapness due to increased efficiency and skill in the arts of production is a benefit; but cheapness which ruins the producer, is one of the greatest economic disasters which can possibly occur."

To remedy this state of affairs, people were asked to save more than usual and all expenditure on public works had to be stopped. The author criticised this view and said that if everyone were to save the whole lot of his income, everyone would be very soon out of work and very soon we should have no incomes to spend. On the other hand, activities of all kinds, local and national, were necessary to restore economic progress. Great enterprises must be set on foot. "To bring up the bogy of inflation as an objection to capital expenditure at the present time is like warning a patient who is wasting away from emaciation of the dangers of excessive corpulence."

In the third book the author discusses the merits of "Deflation" and "Devaluation" for stabilising currency. Deflation has two great drawbacks; it involves a transfer of wealth from all borrowers to lenders; it brings about the ruin of businessmen by increasing their liability and it is not possible, even if desirable, for under it the burden of taxation would become intolerable. Devaluation or the stabilising of the value of a country's currency near its present value and which has been recommended by International Conferences, meets the ends of social justice. The author first arrives at the conclusion that stability of internal prices is more important than the stability of foreign exchange, though the latter was the primary object of financiers in the pre-war days and though it was easily achieved as all the countries of the world were on the gold standard and the fluctuations in the internal prices were very moderate. But when the stability of internal price level and the stability of the external exchanges are incompatible, the former is generally preferable; "Since the restoration of the gold standard will not give complete stability of internal prices and can give complete stability of external exchanges only if all the other countries restored the gold standard, I reject the policy of restoring the gold standard on the pre-war lines."

In spite of the author's warnings, the gold standard was restored by Mr. Churchill in 1925 "in order to improve the foreign exchange value of the sterling up its pre-war value in gold." This premature restoration of the gold standard by the policy of Deflation, increased the disparity between internal and external values, postponed all measures of capital expansion, put the export industries to trouble by reducing their sterling receipts by 10%, increased British wages by 15%, transferred wealth into the pockets of the rentiers, increased the burden of the national debt, unemployment and industrial disputes. To bring about a reduction of wages, the Bank of England restricted credit and this again increased unemployment.

Writing in 1931 soon after the beginning of the world's slump, the author advocated among other things the imposition of a substantial revenue tariff. A wide revenue tariff, which brought in an income of £ 50 m., the author pointed out, would relieve the pressing problem of the budget, restore business confidence, increase employment by the substitution of the home-produced goods for goods previously imported and by curtailing imports relieve the pressure on the balance of trade.

Writing in September 1931, after the

suspension of the gold standard, the author pointed out its great advantages to British trade and industry, the great stimulus to employment and the benefits of higher prices.

Writing about the future, the author is of opinion that there is no need for pessimism about our economic future and that "the standard of life in progressive countries one hundred years hence will be between four and eight times as high as it is to-day."

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BANKS AND THE MONEY MARKET. By Dr. B. Ramachandra Rau, M.A., Ph.D., L.T., F.R.E.S. (Lalchand & Sons, Calcutta. Pp. xxi+257.) Price Rs. 2.

The author of this valuable monograph needs no introduction to our readers. No student of modern banking can afford to forget the association of his name with books like "Elementary Banking," "Present-Day Banking in India," etc. The present monograph which consists of the 4 lectures delivered by the author to the Institute of Bankers during the Winter Session of 1930–31 forms a companion volume to his previously published works on Banking.

The first lecture deals with the ideal Money Market and its organisation; the second with "Expansion and Contraction in the Present-day Currency System." The third lecture concerns itself with "The other Monetary Markets" and the fourth one with the "Ideal Monetary and Banking Standard". Lectures as these are, one would not be justified in expecting a very comprehensive treatment of that wide subject "Banking," for that would involve numerous references to the whole theory of banking and currency as also to the prevalent practices on the continent. Though some of the subject-matter dealt with may seem to be too simple to the trained practical banker, the major portion of the lectures is really helpful to the untrained minds. A number of constructive suggestions and new views are given in the final chapter and it is needless to say that the most experienced bankers, economists and businessmen would find this book a valuable addition to their library.

In conclusion, the author deserves to be congratulated in having placed this invaluable book in the hands of the students of modern banking. The get-up of the book is nice and the price is quite moderate. We have great pleasure in commending this book to all businessmen and students alike.

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A CLASS-BOOK OF BOTANY (For Intermediate and Medical Students), by A. C. Datta, M.Sc., 2nd edition. (Oxford University Press, 1934.) Rs. 4.

Teachers in Indian Colleges have often been embarrassed to recommend to the students of Intermediate Science a text-book of Botany which completely covers their course of study, at the same time is well written, neatly illustrated and is of moderate price. Professor Datta has endeavoured to meet these needs and has successfully done so. We congratulate both the author and the publishers for the handsome volume they have brought within the reach of the Indian student.

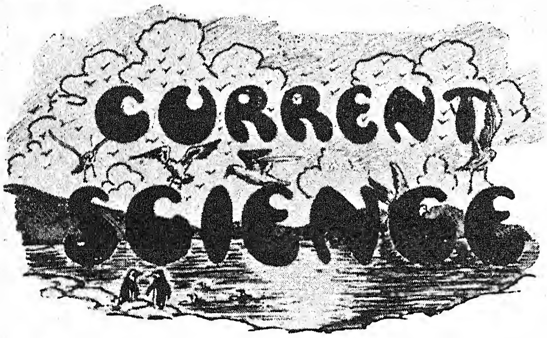
The book follows the usual stereotyped method of dividing it into chapters on Morphology, Histology, Physiology, Ecology and Systematics. While the chapters on the first two and the last subjects receive full treatment, those on Physiology and Ecology are poorly dealt with. We wish that more care and attention had been bestowed upon these two chapters in view of the growing importance of these subjects in the teaching of Biology. We are afraid that the chapter on Ecology as given in the present book will give a wrong idea of the concept of Ecology to the beginner in the study of Botany. Ecology is a study of organisms in relation to their environment and as such, does not merely deal with the classification of vegetation into xerophytes, mesophytes, etc., and the study of the anatomical peculiarities of the various plants, as the reading of this chapter seems to suggest.

Much as we welcome this book we wish that an opportunity had been taken to change the method of treatment of the whole subject. Instead of beginning the book with a chapter on Morphology, Prof. Datta should have given a preliminary chapter on plant life in general and surveyed briefly the scope of Botany; then divided the book into sections on leaf, stem, root, etc., each section treating its subject-matter from all its aspects—morphology, physiology, etc. We feel that such a treatment would have made the book more interesting to the students and would not have given a detached view of the subject as it does at present.

In spite of the above criticisms we strongly recommend the book to students and teachers alike for its excellent get-up, its numerous neat diagrams and its surprisingly low price.

F. R. B.

737–34. Printed at The Bangalore Press, Bangalore City, by T. Subramania Aiyar, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., for the "Current Science" Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore.



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An Indian Society of Soil Science.

THE past few years have witnessed considerable amount of interest in the different branches of Agriculture and especially in Soil Science, which has attracted a number of workers in different parts of India. This is to no small extent due to the keen interest and active support of the Imperial Council of Agricultural Research, who, by their generous grants, have greatly encouraged researches in that and kindred subjects.

At the suggestion of the Imperial Council, a joint meeting of the sections of Agriculture, Chemistry and Botany of the Indian Science Congress held at Bombay on the 15th January 1934 considered a proposal to organise a National Section of the International Society of Soil Science. The meeting approved of the proposal in general terms and appointed a Committee 'to consider the subject in all its aspects and formulate definite proposals regarding the foundation of the same'. The proposals of the Committee as also a draft Memorandum of the Association were considered by the Soil Science Committee of the Imperial Council who passed the following resolution which was subsequently approved by the Advisory Board of that Council—'The Committee endorse the view that the Indian Society of Soil Science should be essentially an unofficial organisation. The draft scheme and by-laws seem to them to be generally appropriate and they commend them to the careful consideration of all soil workers in India.' The provisional Executive Committee have now sent out circulars inviting workers in Soil Science to join the new Society and to offer their comments regarding the draft Memorandum of Association.

It is needless to emphasise that in an essentially agricultural country like India, a Society of Soil Science will be a highly useful organisation that can render excellent service to the cause of agriculture in the country. The subcontinent of India is big enough and the number of workers sufficiently large to justify the creation of not only an All-India Society but also a number of provincial sections devoted to the advancement of the cause of Soil Science. It is rather difficult, therefore, to understand why the special Committee should have proposed the affiliation of the new Society as a branch of the International Society of

Soil Science. It is admitted that the Indian Society should work in close co-operation with kindred societies in Europe and America but why should every member of the former also become a subscriber to the International organisation?

The *International* Society of Soil Science has a useful name with a large measure of popular appeal, but one might well enquire what it has so far done in the East and what the members resident in India can hope to gain by association with it? India has not so far had any representation on the Executive or any one of the numerous Committees or Commissions which that Society has appointed in recent years. It is needless to add that India has not been included in any of their surveys. It is true that all members in different parts of the world are welcome to their periodical meetings and to take part in discussions, but where—Copenhagen, Moscow or New Jersey! One might make a similar observation about the meetings of other learned Societies in Europe or America but there is at least the compensation of good Journals containing a number of original articles. The International Society of Soil Science publishes a *Proceedings* which contains mostly titles (in English, French and German) together with a few abstracts of papers published elsewhere. This compilation is not quite complete: nor is it up-to-date. It does not appear regularly or, at any rate, is not received regularly in India. The Society publishes a quarterly Journal, *Soil Research* which contains a few original articles, but its appearance is also irregular. As for the big congresses which are now being held once in five years, members as well as non-members have to pay the fees. The bulky volumes which represent the proceedings of those meetings are naturally expensive and have to be bought separately. Taking all together, one might well question why it should be made obligatory on the part of the members of the proposed Indian Society to subscribe for the International Society as well. The necessary International Association can be secured by the Indian Society being on terms of exchange with the sister organisation. Such articles as may interest workers in India may be copied or abstracted (with permission) and circulated among the members of the Indian Society. It is not necessary that the Indian Society should undertake to collect subscriptions on behalf of the International organisation or act as transmitting agency for Journals which are normally sent post-free to all subscribers. As for abstracts of publications in Soil Science, excellent service is now being rendered by the Imperial Bureau which is attached to the Rothamsted Experimental Station in England. In addition to fairly prompt publication of abstracts, that Bureau also publishes a number of special bulletins dealing with certain important aspects of Soil Science. The publications of that Bureau are already being received free by a number of research stations in India, so all that is now needed is merely an extension of that service to include the members of the new Society of Soil Science. A satisfactory arrangement would be for the Indian Society to offer to meet the cost of extra printing (or lithographing) and postage so that the Imperial Bureau may post them direct to the individual members.

Perhaps the most important function and at the same time the most difficult task of the new Society will be the organisation of co-operative research in Soil Science. Co-operation in scientific research and that especially in Soil Science is sadly wanting in India with the consequence that there is much duplication of work. Similar and, sometimes even the same problems, are being investigated at different research stations without the workers concerned being able to compare notes with each other. Promotion of co-operative research and that by a non-official organisation, though highly desirable, will be, by no means, an easy task. During recent years, several learned Societies have been started in India and abroad with the object of promoting co-operation among scientific workers but very few of them have succeeded in achieving their end. The failure is not, however, due to the fault of the Societies concerned. The ultimate reason lies in human nature itself, in the desire of the individual scientific worker to do everything by himself and not share credit with others. The tendency is there in almost every one and it is no use quarrelling with it. Even if a few laboratories undertake to conduct co-operative research, it would be very difficult to ensure useful results unless the workers concerned have opportunities to meet each other and discuss their findings. The proposed annual meetings would hardly provide the occasion for such discussions: they would come off during a very busy season when a number of other Societies also hold their annual meetings so that the members will have

practically no time for detailed discussion of specific problems. Special meetings among the interested members is almost out of the question, because India is a country of long distances and slow travel and it would be not only inconvenient but also highly expensive for individual members to attend such meetings.

The new Society would be rendering a very valuable service leading to the elimination of duplication and even facilitating co-operative research if they could arrange to publish periodical (preferably monthly) bulletins giving brief accounts of researches in progress at different experimental stations and the more important results obtained. This could be carried out with the assistance of a number of correspondents, one for each research station in India, Burma and, if possible, Ceylon. The correspondents will send their periodical notes to the Secretary of the Society who will rearrange the matter under different heads with the assistance of a publication committee. The bulletins may also include short reviews of researches spread over long periods or special articles dealing with subjects of general interest.

A publication of the above type will be welcomed by workers all over the country. It will not compete with any of the existing journals but will only supply a long-felt want. It will enable the workers to know what their colleagues are doing and what progress they have made in their researches. The rapid progress made by some workers may be a source of stimulus to their less active colleagues. In many cases, the information provided may be useful in avoiding duplication at other centres. The publication of short notes may also lead to workers engaged in the same or allied lines corresponding with each other and getting further particulars relating to the researches in which they are interested.

As things stand at present, only a small portion of the work done in the country gets to be known through the medium of specialist Journals. The major part gets 'lost' among the numerous provincial reports or bulletins which are not generally known to workers in other provinces, let alone the rest of the World. It is needless to add therefore that the workers will welcome a medium of publication which will ensure better recognition of their efforts.

It would greatly facilitate the work of the publication committee if the correspondents are given the necessary directions with regard to the preparation of their notes—the main heads under which the matter is to be arranged, the space to be allotted to each and so forth. It may also be desirable to offer small honoraria to correspondents for their efforts.

There are also other lines of activity such as preparation of annual reviews of researches in different lines and standardisation of laboratory methods and field technique wherein much useful work could be done. These activities may partly encroach on those of the Imperial Council of Agricultural Research or the Society of Biological Chemists (India), but there is still much specialised work which the Society would be best fitted to take up. The Society can also arrange for public meetings and technical symposia at different centres the proceedings of which can be included in the periodical publications. It would be premature for the Society to undertake the publication of a specialist journal devoted to Soil Science, but it may nevertheless be a useful objective to work for. The volume of research in Soil Science in the country is fast increasing and it may be reasonably expected that there would soon be sufficient material to maintain at least a quarterly journal.

It is perhaps unnecessary to add that the success of the Society, especially in the early years, depends, to a large extent, on the activities of the executive, particularly that of the secretary, whose hands should be strengthened as far as possible. The office as well as the funds should be placed unstintingly at the disposal of the secretary, who, it is hoped, will also have the facilities of a laboratory devoted to Soil Science and a well-equipped library. From this point of view, the proposal of the provisional committee to request the treasurer of another society to collect funds seems to be not only unnecessary but also undesirable. A proper arrangement will be for the secretary himself to act as the treasurer and organise the collection of funds on behalf of the Society. The subject of headquarters has lately become a thorny question in other directions, but it may nevertheless be useful to point out that a society devoted to the study of soils is best attached to a leading research station specialising in the subject—as is the case in other parts of the World.

It is very doubtful if the funds of the Society, especially in the early stages, will

permit of various types of useful activities being undertaken. It should at the same time be pointed out that the future success of the Society will, to a large extent, depend on its making a good beginning and achieving something tangible within the first few years. It is hoped therefore that the Imperial and the Provincial Governments, the Imperial Council of Agricultural Research, the different public bodies and the leading citizens of the country will come forward and assist the Society, in its laudable efforts, with generous grants and liberal donations.

V. S.

The Saline Series of North-Western India.*

By E. R. Gee,

Geological Survey of India, Calcutta.

THE Saline series of north-western India occurs within the Salt Range of the Punjab and in the adjoining district of Kohat in the North-West Frontier Province. In the Salt Range, between the Jhelum and Indus Rivers, it is overlain by Cambrian (possibly pre-Cambrian) strata in the east and mainly by the Talchir Boulder-bed (probably Upper Carboniferous) in the west, though in the vicinity of the Indus near Kalabagh (32° 58′ : 71° 33′), Siwalik strata immediately succeed it. About 17 miles north of Kalabagh, salt-bearing marl and gypsum again crop out along the axes of fold-faulted anticlines over a wide area within the Kohat district. Here it is overlain by sediments of Upper Nummulitic (Middle Eocene) age. Between these two main exposures, about 8 miles north of Kalabagh, two small inliers of the marl with rocksalt occur along the faulted axis of an anticline composed of sandstones and clays of Lower Siwalik (Chinji) and Middle Siwalik age.

The original geological surveys of these areas were carried out by A. B. Wynne of the Geological Survey of India in the 'seventies. The influence of large tectonic thrusts being at that time largely unrecognised, Wynne was very naturally led to conclude that the salt and associated deposits of the two areas were of different geological ages, those of the Salt Range being early Palæozoic (or pre-Cambrian), whilst the salt-bearing marl of Kohat was regarded as of Eocene age.

Since the time of these original surveys, numerous visits have been paid to these areas by geologists and a voluminous literature has accumulated regarding these interesting deposits, at least five different theories having been evolved to explain their age and origin. It should be mentioned, however, that although these theories were often based on the examination of a number of isolated sections within the areas in question, time did not permit the inspection of the whole tract by any one observer. As a result, certain critical sections appear to have been overlooked. In the writer's opinion, there is no doubt that had the evidence of these critical sections been adduced, the 'salt marl' controversy would have been settled long since and the publication of certain of the theoretical opinions would have been spared.

During the past six field-seasons, the Salt Range has been geologically surveyed by the writer and mapping has been continued northwards to link up with the Kohat salt region. In the course of this survey, evidence has come to light that appears to prove conclusively that the Saline series of the two areas are homotaxial and of Eocene (probably Middle-Lower Eocene) age.

In the eastern part of the Salt Range, the greatest development of the Saline series is exposed. It includes an upper stage of massive gypsum with flaggy dolomite and some bituminous shales, varying up to about 200 feet thick, a middle stage of red marl with thick seams of rocksalt, attaining a thickness of at least 600 feet, and a lower stage of marl, gypsum, bituminous shales, and dolomite also several hundred feet thick; the base of the series is not seen. In the Kohat salt region, exposures are mainly of the upper and middle stages.

Evidence regarding the age of the Punjab Saline series is obtained from certain sections in the western end of the Cis-Indus Salt Range. Here, the foraminiferal Eocene limestones (probably Laki), at the top of the Nummulitic Limestone sequence of the

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northern dip-slopes of the range, pass laterally into the massive, white and grey gypsum stage that caps the Saline series. The section, 4 miles east of Daud Khel (32° 53′ : 71° 34′), is extremely clear, the lateral passage from the grey and white limestones into dark, foetid-smelling limestones with subordinate gypsum and the more rapid passage of the latter into massive gypsum (about 300 feet thick) takes place within a few hundred yards. Above the limestones and the gypsum, the Lower Siwalik beds continue regularly, whilst below the limestone-gypsum stage, the light grey shales and limestones and underlying thick nodular limestone of the middle and lower portions of the Nummulitic sequence are observed to crop out with equal regularity. About three-quarters of a mile north-west of the end of these exposures, the massive gypsum is underlain by typical red marl with rocksalt, this apparently taking the place of the light grey shales and limestones of the middle portion of the Nummulitic sequence. The basal nodular foraminiferal limestones are found adjacent to the gypsum and salt marl and underlying it. That this salt-bearing marl and gypsum is the continuation of the main Saline series of the Salt Range is clearly indicated not only by the similarity of the sequence but also by the fact that in the latter outcrop it is associated with the Talchir Boulder-bed in the same manner as occurs in the adjoining scarp slopes of the western half of the Salt Range.

Agreement with the above correlation is expressed by Dr. A. M. Heron, Geological Survey of India, who has recently examined these and other sections in the Punjab Salt Range. An Eocene age is also advocated by P. Evans, Burmah Oil Co., Ltd., who has recently surveyed these critical sections in detail and has examined other portions of the range.

In the Kohat salt region, the equivalence of the Laki Limestone (Middle Eocene) and at least a large portion of the massive gypsum stage at the top of the Saline series of that area had been proved fairly conclusively on stratigraphical and palæontological grounds by D. N. Wadia and L. M. Davies (see *Trans. Min. & Geol. Inst. Ind.*, **XXIV**, pp. 202–222, 1929) and these observers were strongly inclined to regard the underlying salt-bearing marl as of Lower Eocene age. E. S. Pinfold also advocates a Nummulitic age for the Kohat salt. He has arrived at this correlation on stratigraphical grounds by comparing the Kohat sequence with that of the Chharat area of the Attock district, Punjab. More recently, fossil fish of post-Cretaceous type (identified by Dr. E. I. White) were discovered by the writer within the gypsum stage at the top of the Saline series near Malgin (33° 19′ 30″: 71° 31′ 30″), Kohat district. This fossil evidence at least does not conflict with the above-mentioned conclusions regarding the age of the series.

It is interesting to note, therefore, that the conclusions relating to the age of the Saline series of the more complicated and controversial Salt Range area, as deduced from the stratigraphical evidence afforded *within that area alone*, agree closely with those arrived at regarding the similar deposits of the adjoining Kohat tract; namely, that the topmost gypsum and underlying salt-bearing marl stages are of Nummulitic (probably Laki) age.

It is therefore concluded that the Saline series—Upper Nummulitic sequence of the Kohat region is, on the whole, a normal one unaffected by any widespread unconformities or planes of thrusting within it. In the Salt Range, the circumstances are different and a very regular thrust of immense dimensions must be postulated in order to explain the present position of the Saline series beneath the early Palæozoics (or pre-Cambrian) and the Talchir beds. The writer is of the opinion that this overthrust was formed gradually in post-Nummulitic—pre-Siwalik times (movement may have commenced towards the end of the Nummulitic) during the period represented by the important unconformity that underlies the Murree-Siwalik strata of the Salt Range and Trans-Indus Ranges. He concludes that the forces that brought about this immense overthrust during the uppermost Eocene and Oligocene period mark the inauguration of earth-movements which, directed from the north (in the Salt Range area) and from the west (in the Trans-Indus area) finally gave rise during a second period of more complicated folding and thrusting (in late Siwalik to sub-Recent times) to the orogenic belts of the north-western Himalayas, the Hindu Kush and the Sulaiman ranges.

The *nappe* involved in the primary overthrust extended from the Salt Range and Trans-Indus Range sequence (above the Saline series) in the south, through what are now the Potwar, Kohat and Bannu areas, to link up with the stratigraphy of the above-mentioned mountainous regions

to the north and west. At the time of the inauguration of this immense primary thrust at the end of the Nummulitic period, north-western India was, therefore, capped by a thick Nummulitic sequence consisting in places of limestone, shale and sandstone strata, in others of the Saline series sedimentaries including beds of massive gypsum at the top. Two of the principal areas in which the saline facies prevailed were the tract now occupied by the Salt Range (and for some considerable distance to the north and south) and that now represented by the Kohat Salt region. It is quite possible that these two areas of Saline deposition were linked up *via* what is now the Kalabagh-Shakardarra (33° 14′ : 71° 30′) tract. As the intensity of the forces from the north and west increased, it is concluded that a very regular overfold, passing later into a definite equally regular overthrust, was formed along the northern and western boundaries of the Salt Range saliferous tract. The massive gypsum capping the salt-bearing marl doubtless formed a very suitable lubricating medium above which the *nappe*, consisting of Palæozoic (including the Purple Sandstone series), Mesozoic and Nummulitic (including the Saline series of Kohat) rocks, slid with ease whilst the absence of any *massif* for some considerable distance to the south afforded equally favourable circumstances for overthrusting on a large scale. Over-riding across the Saline series of the Salt Range area, up to a distance of *at least* 20 miles towards the south (as indicated by inliers of the Saline series at Vasnal and Kallar Kahar on the Salt Range plateau), therefore took place during this post-Nummulitic—pre-Siwalik interval resulting in the relative uplift of the *nappe* in the area in the vicinity of what are now the Salt Range and Trans-Indus Ranges. Concurrently, a geosynclinal tract was formed in the Potwar to the north and the Kohat and Bannu areas to the north-west and west.

A period of relative quiescence then followed in mid-Tertiary and early upper Tertiary times during which the Murree and Siwalik sediments were laid down in this geosyncline. During a considerable part of this period, the relatively elevated Salt Range and the Trans-Indus Ranges were eroded to a greater or less extent, the amount of erosion increasing in both areas to the rise, that is, towards the south in the former area and towards the east in the latter. In the more elevated tracts, denudation continued in places well into Siwalik times exposing a land-surface composed of Palæozoic and Mesozoic rocks of the primary *nappe*. Upon this eroded land-surface, the Middle Siwaliks transgressed. During this period of erosion and subsequent Siwalik deposition, the salt marl and associated deposits of the Salt Range were of course protected by the strata comprising the primary *nappe*.

In late Siwalik to sub-Recent times, a second period of acute earth-movement prevailed, the forces coming from the same northerly and westerly directions. However, owing to the fact that by the end of the primary movements the *nappe* had been brought southwards and eastwards to the vicinity of an Archæan *massif*, remnants of which exist in the Kirana hills about 40 miles south of the Salt Range, appreciable further sliding in these directions was impeded. Therefore, with the increase of the orogenic forces, the acute folding and shearing of the strata forming portions of the Potwar-Kohat-Bannu geosyncline took place and similar folding and duplication by thrusting occurred near the outer edges of the primary *nappe* in the Salt Range and Trans-Indus Ranges. At the time of this second phase of acute earth-movement, however, the Nummulitic Saline series of the Salt Range area was underlying the older beds of the *nappe* and naturally acted in close association with these overlying Palæozoic strata, being folded and sheared along with them as though it were a portion of a normal stratigraphical sequence. This explains the intimate relationship of the Saline series and the Palæozoic rocks throughout the greater length of the Salt Range.

Striking evidence of the very recent age of certain of these acute earth-movements is afforded not only by the steeply-dipping post-Siwalik sands, clays and conglomerates of the Salt Range plateau, but also by the occurrence of relatively very recent beds intercalated within the gypseous marl stage near the base of the scarp in the eastern part of the Cis-Indus Range. Here, in close association with this gypseous marl, we find beds of red clay and soft sandstone, including boulders of gypsum, dolomite and Khewra trap (derived from the Saline series), Purple Sandstone and Magnesian Sandstone. The gypseous marl is often greatly disturbed (brecciated, sheared and foliated) and the associated more recent

deposits also show high dips in general conformity to those of the normal marl. These very recent deposits vary from thin lenticular inclusions, up to more regular sediments over 200 feet in thickness. It is concluded that these beds, derived by the erosion of the Salt Range scarp and deposited at the foot of the range, were caught up among the strata of the gypseous marl stage during the above-mentioned period of acute post-Tertiary earth-movement.

The occurrence of these beds and the similarity of some of them to beds of the Saline series makes it difficult to be sure of the value of any fossil evidence that may be found. Some of the deposits of this type contain derived foraminifera and it is possible that all the foraminiferal bands hitherto discovered are later than the Saline series. Plant fragments, however, have been found not only in beds of doubtful age but also in beds which are regarded as being definitely *in situ* in the Saline series; thus providing independent evidence that the Saline series is not Cambrian.

Regarding the question of structural evidence of the postulated primary thrust-plane, it has been observed by earlier writers that the overlying Purple Sandstone strata (Cambrian or pre-Cambrian) show signs of brecciation and slickensiding near their junction with the massive gypsum that forms the uppermost part of the Saline series. This disturbance appears to be on too large a scale to be explicable by the difference in competence of the beds above and below the junction. More definite evidence is provided by the beds beneath the junction, the gypsum bands being often found contorted and the hard cherty and dolomitic layers definitely brecciated.

Still more convincing is the evidence afforded by the Talchir Boulder-bed in the vicinity of its junction with the underlying gypsum. Throughout a distance of about 30 miles in the western part of the Salt Range, this conglomerate directly overlies the Saline series and there are numerous clear sections showing the junction of the two series. In these exposures, throughout a thickness varying up to about 20 feet above the junction, the stratification of the shale matrix has been obliterated and the majority of the included boulders, consisting of hard granites, gneisses, quartzites, rhyolites, etc., have been crushed and sheared, the sheared fragments being often held together by growths of secondary gypsum (selenite) brought up by capillarity from the underlying Saline series. In those sections in the eastern and middle parts of the Salt Range, where the boulder-bed rests on the early Palæozoic or pre-Cambrian strata, no evidence of such disturbance is observed.

In conclusion, it should be mentioned that the above-described opinion regarding an immense regular overthrust in pre-Siwalik times follows in many essentials the theory postulated by Sir Edwin Pascoe in his memoir entitled 'Petroleum in the Punjab and North-West Frontier Province' (*Mem. Geol. Surv. Ind.*, **XL**, Pt. 3, pp. 363-371, 1920). The idea of an overthrust of this type was previously held by Sir Thomas Holland and Drs. Koken and Noetling.

"Current Science" and "South Indian Science Association".

OUR attention has been drawn by one of our Editorial co-operators and one correspondent to the effect that Dr. S. Subba Rao, President, South Indian Science Association, in his opening address at the Easter Congress of Scientists at Bangalore, claimed *Current Science* as an organ of the South Indian Science Association. On referring the matter to him, Dr. Subba Rao has written to say that he made no such statement.

It is needless to emphasise that *Current Science* is an independent all-India Journal and stands for the progress of scientific work in India as a whole.—*Editor.*

Studies on the Pollen-Tubes.

II. The dependence between the potency of the pollen-tube growth in foreign styles and the thickness of the pollen-tubes and chromosome number.

By Dontcho Kostoff.

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IN investigating the problem of the interspecific hybrids in *Nicotiana*, we stated that the following conditions are necessary for the successful production of the hybrids: (1) germination of the pollen of the paternal plant on the stigma of the maternal plant, (2) a necessary growth potency of the pollen-tubes in order to reach the ovary and penetrate into the micropyle of the ovule, (3) the occurrence of fertilization, (4) a satisfactory growth of the hybrid embryos, (5) germination of the seeds produced following hybridization, (6) surviving of the seedlings during the cotyledon stage and further development until maturity.

Previous investigations (Kostoff 1930, and Prokofieva 1934) showed that a definite dependence exists between the growth potency of the pollen-tubes and the length of the styles of the species from which the pollen originates. The longer the styles the plant has the greater growth-potency the pollen-tubes possess. The length of the styles of the maternal species plays an important rôle too. The shorter the styles are (the shorter the way between the stigma and the ovary) the sooner the pollen-tubes reach the ovary. When the styles of the maternal species are considerably longer than those of the paternal one, the pollen-tubes usually do not succeed to reach the ovary and the hybridization fails.

Further investigations show that this is not the single cause for the failure of the hybridization. The measurements of the pollen grains and the pollen-tubes we carried out lately show definitely that in many cases the nucleoplasmic ratio of the pollen and further of the pollen-tubes represents a regulating factor for the velocity of the pollen-tube growth too.

The data given in Table 1 show that species with larger chromosome numbers (given there) have larger pollen grains. The same dependence seems to exist between the number of the chromosomes and the thickness of the pollen-tubes as shown in Tables 2 and 3. This is true for the auto-tetraploid forms when compared with the diploid forms. It also seems to be true for the amphidiploids (tetraploids) in relation to their parents and for the very closely related species but obviously not for the far related species.

The pollen-tubes of the tetraploid tomato ($4n = 48$) do not reach the ovary of the diploid ones ($2n = 24$) while in the reverse cross, namely $2n \times 4n$, the pollen-tubes of

TABLE 1.

Species	Chromosomes ($2n$) in the soma	Diameter of the pollen grains in microns										
		20	23	25·7	28·6	31·5	34·3	37·2	40	42·9	45·8	48·6
Nicotiana rustica ..	48	..	..	..	..	1	25	89	63	22	..	..
N. paniculata	24	..	1	17	39	105	28	3	..	..	..	..
N. rupa, *i.e.*, an amphidiploid of *rustica* × *paniculata*	72	..	..	..	..	..	6	18	25	119	21	1
N. glauca	24	..	..	..	20	66	24	..	..	..	..	..
N. Langsdorffii ..	18	..	1	38	64	18	..	..	..	..	..	..
N. glauca × *Langsdorffii* amphidiploid ..	42	..	..	..	..	3	19	92	85	26	..	..
S. Lycopersicum (tomato) diploid ($2n$) ..	24	10	174	17	..	..	..	..	..	..	..	..
S. Lycopersicum—tetraploid ($4n$) ..	48	..	3	47	129	21	..	..	..	..	..	..

TABLE 2.

Species	The thickness of the pollen-tubes in micrones															
	5·7	6·4	7·2	7·9	8·6	9·3	10	10·7	11·4	12·2	12·9	13·6	14·3	15·0	15·7	16·4
Nicotiana rupa ..	..	..	..	..	1	3	3	2	26	6	7	7	24	4	12	4
N. rustica ..	..	..	..	..	22	16	18	7	30	1	3	3	1	..	..	..
N. paniculata ..	2	3	8	14	50	16	7	1	2	..	..	..	..	..	..	..

TABLE 3.

Form	The thickness of the pollen-tubes in micrones											
	47	52	57	62	67	72	77	82	87	92	97	Total number
Diploid tomato ..	1	81	62	15	3	1	..	..	..	..	..	163
Tetraploid tomato ..	..	..	..	1	..	42	48	31	37	18	3	180

$2n$-plants with n-chromosome number reach the ovaries of the $4n$-plants.

The pollen-tubes of *Nicotiana rupa*, an amphidiploid plant from the F_1 (*N. rustica*, $n = 24 \times$ *N. paniculata*, $n = 12$), reach the ovary of *Nicotiana rupa* and of *Nicotiana rustica*, but rarely of *N. paniculata*, while the pollen-tubes of *rustica* and *paniculata* reach easily the ovary of *N. rupa*.

The pollen-tubes of the amphidiploid plants of *N. glauca* (n=12) × *N. Langsdorffii* ($n = 9$) do not reach the ovary of *N. Langsdorffii*, while the pollen-tubes of *N. Langsdorffii* reach easily the ovary of the amphidiploid hybrid which has 42 somatic chromosomes. We must here point out that the length of the styles is in favour of the cross *N. Langsdorffii* × amphidiploid (*glauca* × *Langsdorffii*), though the pollen-tubes do not reach the ovary in this cross combination but in the reciprocal one. Consequently, the thickness of the pollen-tubes seems to be here also the responsible factor.

In order to be able to estimate correctly the importance of the chromosome number in the pollen-tube growth process following inter-specific crosses, the factor "length of the styles" must be eliminated. The investigations in *Triticum* inter-specific hybrids show that the crosses $4n \times 6n$ are more successful than the reciprocal $6n \times 4n$ (Literature, see in Katayama, 1933). There is not a definite rule in *Nicotiana* if we do not consider the length of the styles. Thus, for example, the pollen-tubes reach easier the ovary in the following cross combinations: *N. rustica* ($n = 24$) × *N. Tabacum* ($n = 24$), *N. rustica* × *N. paniculata* ($n = 12$), *N. Tabacum* × *N. sylvestris* (n=12), *N. Tabacum* × *N. glauca* ($n = 12$), *N. glauca* × *N. Langsdorffii* ($n = 9$), *N. paniculata* × *N. Tabacum*, *N. suaveolens* ($n = 16$) × *N. Tabacum*, *N. glutinosa* (n=12) × *N. Tabacum*, *N. Langsdorffii* × *N. longiflora* ($n = 10$), etc., than in the reciprocal crosses. If we judge these examples as they are without consideration of the other factors involved in the pollen-tube growth, we must conclude that there is not any dependence between the number of the chromosomes and the growth of the pollen-tubes. Such a conclusion is undoubtedly wrong. In order to have really an unquestionable criteria of the significance of the chromosome number in the parental species for the velocity of the pollen-tube growth we must unconditionably consider the length of the styles of the species crossed, and which plant is used as maternal one. In other words, the factor "length of the styles" must be eliminated, and then the study of the crossability of the species with various chromosome numbers in relation to the velocity of the pollen-tube growth can be possible. For such a study we must

take species that have approximately the same length of the styles, but different chromosome numbers.

The middle lengths of the styles of some *Nicotiana* species are given in Table 4. *N. Tabacum* var. *macrophylla* has a style of about 42 mm. *N. Sanderæ* of about 40 mm. The pollen-tubes of *N. Sanderæ* reach the ovary of *N. Tab. macrophylla*, while the pollen-tubes of *N. Tab. macrophylla* do not reach the ovary of *N. Sanderæ*. *N. Rusbyi* and *N. Tabacum* var. *sanguinea* have

TABLE 4.

Species	Somatic chromosome number	Approximate length of the styles in mm.
N. longiflora[1]	20	ca. 85
N. Tabacum var. *macrophylla*	48	ca. 42
,, ,, ,, *sanguinea*	48	ca. 34
N. Langsdorffii	18	ca. 17·5
N. glauca	24	ca. 25
N. paniculata	24	ca. 24
N. glutinosa	24	ca. 20
N. Sanderæ (pink)	18	ca. 40
N. Rusbyi	24	ca. 33
Petunia violacea	14	ca. 7
N. rustica	48	ca. 10–12

[1] The environmental conditions and even the age of the plant influence somewhat the length of the styles.

approximately the same length of the styles, though different chromosome numbers, and the pollen-tubes of *N. Rusbyi* reach the ovary of *N. Tabacum sanguinea*, while those of the latter do not reach the ovary of the former. *N. Langsdorffii* has even shorter style than *N. Rusbyi*, *N. paniculata*, *N. glauca*, *N. Tabacum* and *N. glutinosa*, but it has $n=9$, *i.e.*, less than any one of these species and its pollen-tubes reach the ovaries of all these species, while in the reverse crosses only the pollen-tubes of *glauca* may in exceptional cases reach the ovary of *N. Langsdorffii*. *Langsdorffii* pollen-tubes may sometimes reach even the ovary of *N. longiflora*, a species with the longest styles.

Petunia violacea is a species very closely related to those of the genus *Nicotiana*. It has a very short style, though its pollen-tubes reach easily the ovaries of *N. Langsdorffii*, *N. Rusbyi*, *N. paniculata*, *N. glutinosa*, *N. glauca*, and even that of *N. Tabacum*, while the pollen-tubes of all these *Nicotiana* species cannot reach the ovary of *Petunia*. It is probably because *Petunia* has only $n = 7$ and $2n = 14$.

From the data here reported we can conclude that the thickness of the pollen-tubes plays an important rôle in the species and variety crosses; the thicker pollen-tubes grow slower than the thinner ones. When we eliminate the factor "length of the styles" by considering only such species that have approximately the same length of the styles one sees the following tendency: the pollen-tubes, originating from species that have larger chromosome number, grow slower in the styles of species having smaller chromosome number, than those originating from species with smaller chromosome number, when growing in styles of species with larger chromosome number. Consequently, a species cross A×B would be more successful than its reciprocal B×A, when A has larger chromosome number than B, because the pollen-tubes of B reach easier the ovary of A than in the reverse cross.

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Recent Developments in "Aero-Electrics".

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THE alarming rate at which the world's supply of coal and oil is being used up, persuades the industrialists to assess its reserves: of what may be regarded as inexhaustible power-producing materials, such as wind, tide, solar energy, timber and all vegetable products capable of yielding alcohol. The scarcity of fuel caused by the war has revived the interests of engineers, specially towards the immense and ever present power which is available in the winds. At present many people regard wind-power as of negligible importance, but the intensive researches carried out in various countries lead to the fact that wind is a much more dependable source of power than hitherto expected. The entire water-power resources of the world would be negligible against the gigantic potentialities of wind power. Given proper conditions, it can be turned to a very practical account. Russia has already ascertained that the winds blowing over the Soviet Union contain a potential generative power of some 10,000 million KW. Previously the feasibility of erection of windmills was only possible in low-lying countries as in Holland where a wind of medium strength is almost constantly blowing: and innumerable mills like these are already under successful operation in various countries, not as an industrial concern but as small units for isolated communities. Amongst the scientific investigators the name of the Danish physicist Professor Poul la Cours comes first being the pioneer, but the aircraft industry is solely responsible for enabling the manufacturers to be certain about the actual performance of their windmills in accordance to the designs.

The meteorological data for selecting the most favourable spot with known nature of the disposable wind energy previous to the erections of windmills is as essential as the hydro-electric survey before launching a water-power scheme. Actually the central Aero-hydrodynamic Institute of Moscow has already kept themselves busy in obtaining information about their country through the agency of 1,387 meteorological observatories and at the same time striving to improve the machinery, designed and constructed for the wind-power establishments. At present we can look upon three types of wind-power generators which will enable the electric energy supply on a commercial scale: (1) The improved form of those found to be most suitable by Danish people empirically; (2) The Rotating Cylinder invented by J. D. Madaras, an U.S.A. engineer; the principle being the same as employed by A. Flettner for propelling his wind-driven rotor ship; (3) The high-zone-wind-Power Stations where the wind turbines will be placed as high as 1,500 ft. above the ground surface.

TYPES OF WHEEL.

The maximum amount of power which can be extracted out of the air depends on suitably designing the blade-form concerning its effective area and profiles. These wheels are divided into two classes: *viz.*, slow or high speed runners. A high-speed runner evidently differs from a slow-speed one in having very few long and narrow blades. Governing of speed is generally done by a couple of springs in the former, while an auxiliary vane mounted normally brings the desired effect for the latter. Only very recently the invention of 3–6 bladed fast rotors with automatic adjustable propeller profiles (Fig. 1) have rendered the use of storage accumulators unnecessary.

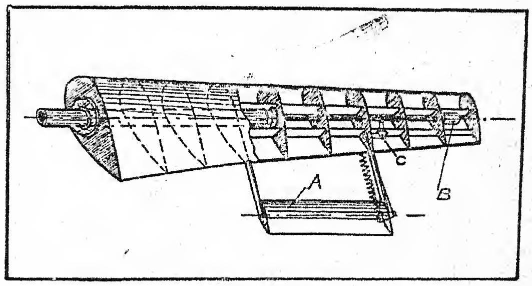

Fig. 1.
Stream-lined self-regulating blades.

Besides the successful operation in Baku of a 45 ft. diameter windmill (Fig. 2) in connection with oil industry, the improvised experimental wheel of 100 ft. diameter at Balaklava in Crimea (Fig. 3) has satisfactorily withstood a year of continuous operation, under the rigours of climatic variations, thereby firmly establishing the possibilities of utilising the energy of the

wind in parallel with the existing hydro-electric plants, particularly in winter when

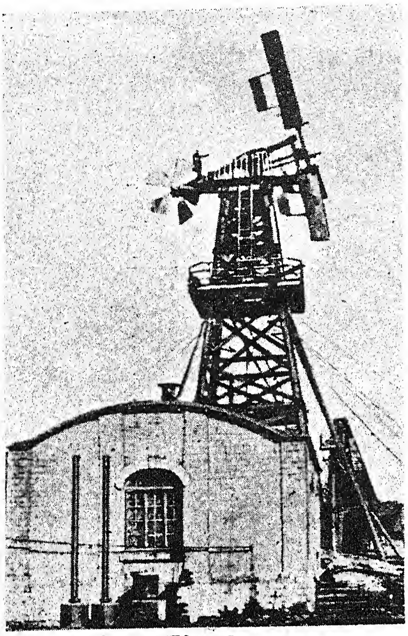

Fig. 2.
45 feet diameter windmill in Baku.

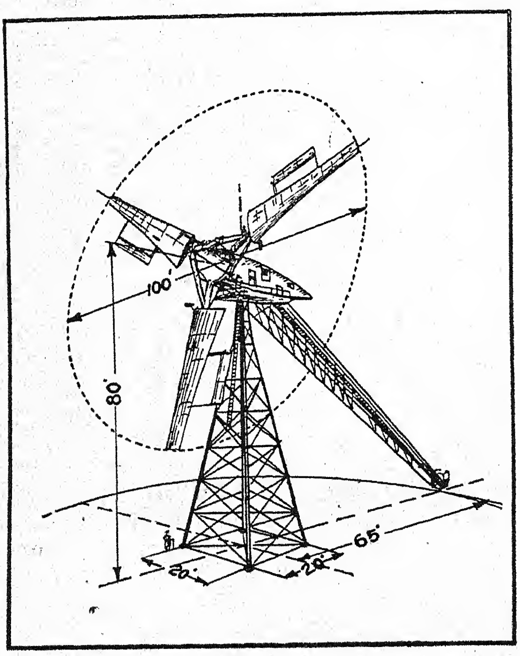

Fig. 3.
100 feet diameter windmill in Balaklava.

in cold countries many rivers, supplying hydro-electric schemes, are ice-bound. Both of them are fitted with three self-regulating blades as shown in Fig. 1. Here the weight B controls the pitch of the blades for constant speed centrifugally in relation with the wind velocity changes, by governing the movements of A through the lever C. The stream-lined blades made out of light wood and metal at Balaklava are each 35 ft. long with the greatest width of 7·5 ft. The inclined shaft of this 100 ft. wheel has been geared with an asynchronous 100 KW. generator rated at 220 volts, 3-phase, 50 cycles, 600 syn. r.p.m. with a power factor of 84 per cent. Special thrust bearings have been provided to compensate the inclination. The machine room is housed inside a steel framed structure and the whole rotates on a spherical pivot on top of the 85 ft. high tower. The structure is connected with a tail-piece (containing the ladder) which terminates on a motor driven platform rotating on a circular track of 65 ft. radius. The motor on the platform is automatically actuated by a directional vane over the machine room to throw the wheel into the wind. When the unit arrives at synchronous speed the generator is automatically cut in, and after the wind dies down the generator is automatically cut out until the wind rises again. The safety of the equipments is assured by means of an automatically controlled protective system. Three phase 220 volts power is transmitted from the generator by a sliding connection and cables to the power house for stepping up to 6·6 KV. for the network. Low voltage generation was adopted for the safety of the experimenters. The erection of a 30,000 KW. set is under schematic form in view of the extreme dependability of this set.

Rotating Towers of J. D. Madaras.

This unique contrivance is the outcome of a very recent enterprise. An industrial plant according to the proposed scheme will consist of twenty or more duraluminium cylinders, each 90 ft. high and about 25 ft. in diameter, capped on the top by discs extending 5 ft. beyond its circumference (Fig. 4) and so mounted on bearings that it can turn freely. Each will be placed on a truck and independently driven by a small motor. The towers being smooth surfaced and at the same time moving in a stream of air is bound to develop an increased translational force in accordance with "Magnus Effect", an experimental fact after the German physicist

Magnus, who first demonstrated it in 1852. This force will be utilised in driving the trucks around a circular track and the production of electric power will be effected by huge generators geared to the wheels. Even a wind velocity of 10 m.p.h. is able to produce a peripheral velocity of 50 m.p.h. in the tower. Each such unit will weigh 150 tons and can be depended upon to generate 1,000 KW. On the basis of preliminary calculations it is claimed that the installation costs per KW. will be only about £ 10, $\frac{1}{5}$th the average cost of a hydro-electric plant. By establishing such generating stations in specially windy location, we can tide over the greatest problem—what to do when the wind refuses to blow ?

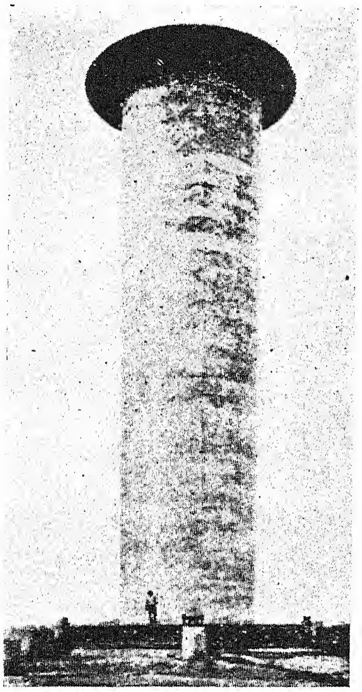

Fig. 4.
The experimental rotor of Madaras in New Jersey.

HIGH-ZONE WIND POWER STATIONS.

This is the last and a very bold attempt on the part of a German engineer Herr Herman Honnef to harness the wind for power. With the materialisation of this plan the question of a favourable and suitable location can easily be dispensed with as there is always plenty of wind high above the earth's surface. The idea is to erect five "windmills" on the top of a colossal tower 1,500 ft. high made out of welded steel tubes. Each will be 250 ft. in diameter and the unit is speculated to generate 50,000 KW.

The modified electric generators have already assured the future of small windmill installations, as hundreds of them have been giving good service for a period of years. Also the difficulties in the regulation of big wheels especially in storms, and direct linking to high voltage transmission systems, are sure to be surmounted within a very short time due to the sincere interest evinced by engineers all over the world to obtain the cheapest energy from nature.

Lyochromes.

RECENT work on the chemistry of a new group of pigments of great physiological importance, now called Lyochromes, has yielded very valuable information regarding their constitution (*Nature*, 1934, **133**, 553-56). These animal pigments are related to Warburg's respiratory ferment on the one hand, and to vitamin B_2 on the other. They are insoluble in the common neutral organic solvents but are soluble in water, and exhibit a characteristic yellow-green fluorescence which changes reversibly to a violet fluorescence on addition of acids or alkalies. Further, they are reversibly reduced to a leuco-base by reducing agents such as hydrosulphite while being highly resistant towards oxidising agents.

One of the richest sources of these pigments is whey from which they can be adsorbed by fuller's earth. The adsorbate can be washed with alcohol and water and eluted by pyridine. By employing this technique, Ellinger and Koschara obtained concentrates from which five crystalline coloured substances designated lactoflavines *a–e*, were isolated. These five substances differ from each other in their crystalline form, solubility and intensity of colour in solution. The flavines *a*, *b* and *c* answer the murexide test and on warming in solution decompose into soluble pigments and substances of a purin character; they are therefore called purin-lyochromes. Lactoflavine *d* gives a negative murexide test while *e* gives the test only with chlorate and hydrochloric acid. B. N. S.

Letters to the Editor.

The Anomalous Scattering of α-Particle.

IN a recent paper[1] on the anomalous α-scattering I have established the following formula:—

$$D/D_\circ = \left[1 - \frac{\dfrac{4\pi^2 r_\circ^2}{\lambda^2} \operatorname{Sin}^2 \theta/_2}{\operatorname{Cos}\left(\dfrac{4\pi r_\circ}{\lambda} \operatorname{Sin} \theta/_2 \right)} \right]^2 \quad .. \text{ (1)}$$

where $D_\circ$ denotes the number of particles scattered with Coulomb force, D the number when the additional polarisation force is supposed to vary as $^1/_{r^5}$, θ the angle of scattering, λ the wave length and $r_\circ$ the closest distance of approach of the α-particle from the centre of the nucleus. The values of $D/D_\circ$ as obtained from the above formula are in very good agreement with the experiments of Bieler and Chadwick for all angles of scattering. It was suggested in the paper referred to above that the small discrepancies, where such existed, between the calculated and experimental values might be obviated if instead of taking $r_\circ$ to be a constant we assumed it to depend on θ and also on the range or the velocity of the α-particle. Here I shall study the small variation of $r_\circ$ with the variation (1) of velocity (see Fig. 1) and (2) of the angle of scattering (see Fig. 2).

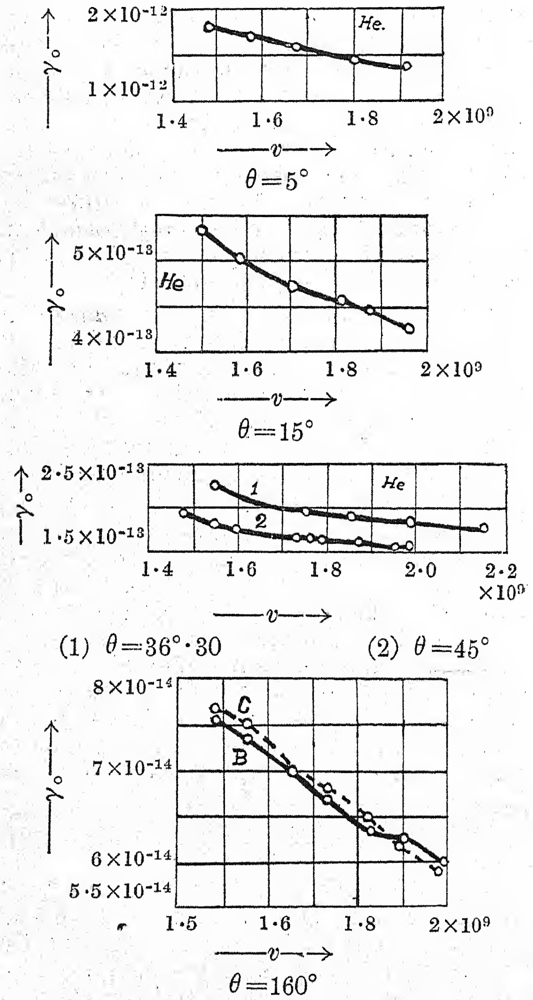

Fig. 1.

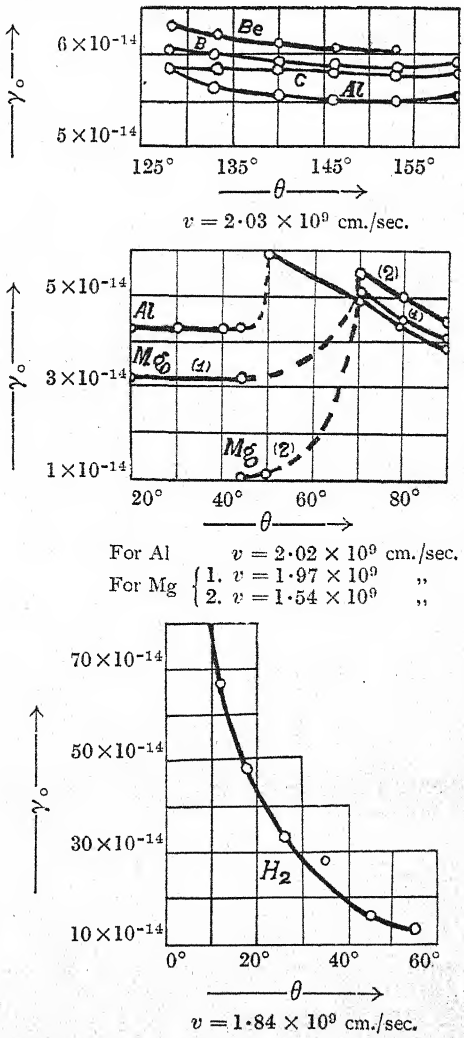

Fig. 2.

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[1] *Phys. Zeit.*, **34**, 175, 1933. See also *Current Science*, page 217, January 1933.

In determining these small variations the theoretical values of D/D_0 have always been made to agree with the experimental values.

It will be seen from the curves that in all cases r_0 slightly decreases with the increasing normal component obtained on multiplying the incident velocity by Sin $\theta/_2$. This is as it should be, when we remember that the α-particle moves against the repulsive force of the nuclear charge. The curves, with the exception of those obtained from Bieler's data, are quite interesting inasmuch as they are not only continuous but are all of the same type. The curves obtained from Bieler's data are all characterised by anomalous discontinuities. The curve for Aluminium from Bieler's data from observations at small angles has a discontinuity whereas that for the same element from Chadwick's data at large angles is free from any discontinuity. One might be tempted to conclude from this that Chadwick's data are more reliable than those of Bieler. In the case of Hydrogen and Helium the theoretical value of r_0 for small angle scattering is about ten times the value for large angle. It is remarkable that this is nearly the ratio obtained by Rutherford and Chadwick[2] for Helium. From the curves generally and especially from those obtained from the more up-to-date data of Chadwick[3] and Reizler[4] we see that r_0 is practically a constant which was the standpoint taken up in my previous paper and which, as has been shown there, gave a very good agreement with the experimental results. For exact agreement, however, r_0 varies slightly with the variation of the angle of scattering and also with the velocity of the α-particle. The nature of this small variation, it appears, will remain inexplicable so long as the yet undiscovered facts about the structure of the nucleus are not forthcoming.

K. K. MUKHERJEE.

Serampore College,
Serampore,
Bengal.

April 27, 1934.

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[2] Rutherford and Chadwick, *Phil. Mag.*, **4**, p. 605, 1927.

[3] Chadwick, *Proc. Roy. Soc.*, **134**, 154, 1931.

[4] Reizler, *Proc. Roy. Soc.*, Nov. 1931.

The Wave-Statistical Theory of Artificial Disintegration.

IN a recent paper[1] we have given a theory of the spontaneous disintegration of the α-particle. It is in very good agreement with the experiment. The theory is based on the perfectly natural assumption that the phase density for the hard core within the nucleus is very great compared with the surrounding. Consequently, the statistical waves set up there are damped just as the hydrodynamical waves in a viscous fluid. Here the damping coefficient and so the viscosity effect is positive.

Now it may happen, specially for lighter elements, that under certain conditions the phase-density for the hard core is extremely small compared with the surrounding. This evidently occurs when the nucleus is bombarded by the α-particle and after sufficient penetration it is captured by the core. It is easily seen that in such a case of capturing the damping coefficient for the core should be taken negative. There is no difficulty in imagining a negative damping coefficient or a negative viscosity-effect when it is remembered that they are all relative.

It may be mentioned in this connection that it follows from the fundamental law of duality in nature that if anything, *e.g.*, the damping coefficient, is positive there must exist some phenomenon which corresponds to its negative value. This, in fact, is what Dirac calls the 'Duplexity phenomena'.

From what has been said it is obvious that the artificial disintegration of protons by the lighter elements may be looked upon as a double process of capturing of the α-particle by the core followed by spontaneous emission of the protons. Now in our previous theory the relevant differential equations involve the square of the damping coefficient. So they are unaffected by its negative value. Thus the extension of the previous theory to the present case is almost immediate and we have,

$$\lambda = C. \frac{\sqrt{E_1 E_2}}{h^2 \gamma^2_{01} \gamma^2_{02} \text{Cot}\, u_{01} \text{Cot}\, u_{02}} \times$$
$$exp. -\{2k_1(2u_{01} - \text{Sin}\, 2u_{01}) - 2k_2(2u_{02} - \text{Sin}\, 2u_{02})\}$$

where the suffixes 1 and 2 are respectively for the α-particle and the proton. The different symbols have the same meaning as in our recent note in *Current Science.*[2]

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[1] *Phil. Mag.*, **16**, 1097, 1933.

[2] K. C. Kar, *Curr. Sci.*, **2**, 387, 1934.

The agreement of the above formula with the experiment is highly satisfactory as is obvious from the curves for nitrogen and fluorine in which the experimental curve is dotted where it departs from the theoretical. For verification of both the parts of the formula we have taken two cases (1) protons of given velocity emitted by nitrogen when bombarded by α-particles of different velocities, and (2) protons of different velocities, emitted by fluorine when bombarded by α-particles of a given velocity.

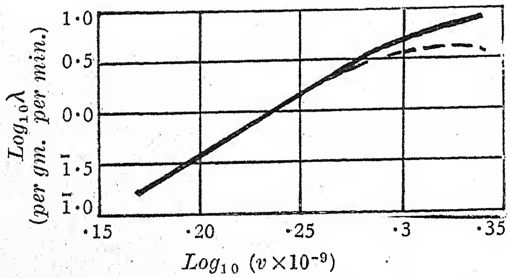


Fig. 1.—Nitrogen.

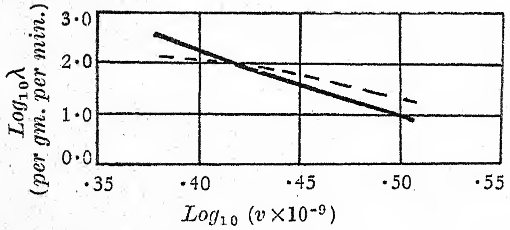


Fig. 2.—Fluorine.

The data are taken from *Radiation from Radioactive Substances*, by Rutherford, Chadwick and Ellis, and also from the publication of Chadwick and collaborators.[3]

In conclusion we may mention that as far as we know the above is the only formula of its kind.

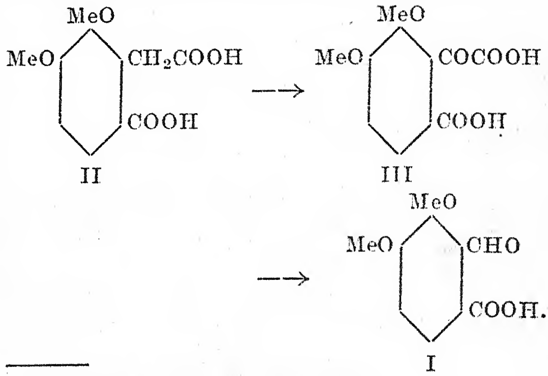
K. C. KAR.
A. GANGULI.

Physical Research Laboratory,
Presidency College,
Calcutta,
April, 1934.

[3] Chadwick, Constable and Pollard, *Proc. Roy. Soc.* **130**, 463, 1931.

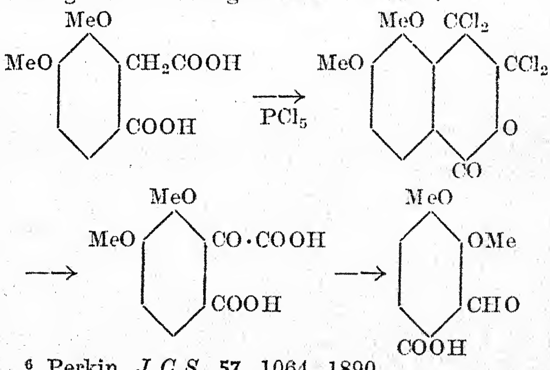
A Synthesis of ψ-opianic acid, and a new general method of Synthesising Phthalonic Acids.

NUMEROUS unsuccessful attempts have been made in the past to synthesise ψ-opianic acid (I) [1-5,*] ψ-Opianic acid which had been first obtained by Perkin by the hydrolysis of Berberal[6] and which has been more recently obtained by the oxidation of β-Pseudo-gnoscopine[7] has now been synthesised by us by a simple method which should be capable of wide extension. The method consists in boiling 5:6-dimethoxyhomophthalic acid (II) with equimolecular quantity of selenium dioxide in Xylene solution when the phthalonic acid (III) is obtained in excellent yields. The phthalonic acid was readily converted into ψ-opianic acid through its sodium bisulphite compound under the conditions previously described by one of us[8].



[1] Solomon, *Ber.*, **20**, 888, 1887.
[2] Perkin and Stoyl, *J.C.S.*, **123**, 3173, 1923.
[3] Edwards, Perkin and Stoyl, *J.C.S.*, **127**, 196, 1925.
[4] Chakravarti, *J. Ind. Chem. Soc.*, **6**, 208, 1929.
[5] Robinson, "On Life and Work of Perkin," p. 80.

* We have also synthesised ψ-opianic acid through the following alternative route:—



[6] Perkin, *J.C.S.*, **57**, 1064, 1890.
[7] Robinson, *J.C.S.*, 1376, 1932.
[8] Chakravarti, *J. Ind. Chem. Soc.*, **10**, 696, 1933.

The acid thus obtained had all the properties of ψ-opianic acid obtained by Perkin. For confirmation of its identity it was reduced to ψ-meconine m.p. 124, and also converted into its oxime, m.p. 124 and hemipinimide. The mixed melting point of these derivatives with the corresponding authentic specimens caused no depression.

The oxidation of several other homophthalic acids to the corresponding phthalonic acids by means of Selenium dioxide has also been studied. In every case an excellent yield of the phthalonic acid is obtained. Homophthalic acids being readily available substances, this new method of synthesis should prove to be a valuable one.

S. N. CHAKRAVARTI.
M. SWAMINATHAN.
Annamalai University,
May 2, 1934.

Changes in the Charge on Colloidal Particles during Dialysis of Sols.

IN papers* published from our laboratory we have put forward the view, on the basis of experimental evidence, that a colloidal solution when subjected to dialysis will show first an increase and then a decrease or a continuous decrease in the cataphoretic speed according as the amount of the peptising electrolyte initially present is more, or equal to or less than the amount corresponding to the maximum in the cataphoretic speed-concentration curve of that sol with the particular (peptising) electrolyte. Colloidal solutions of gold, ferric hydroxide and thorium hydroxide have been found to conform to this behaviour. S. G. Chaudhury† has also observed in the case of colloidal solution of copper ferrocyanide containing very high concentrations of potassium ferrocyanide that with the progress of dialysis the cataphoretic speed first increases and reaches a maximum after which it decreases.

We have been investigating other collodial solutions from the point of view stated above and have observed that the prussian blue sol (peptised with oxalic acid solution) when subjected to dialysis shows a behaviour similar to the colloidal solutions of gold, ferric hydroxide, thorium hydroxide and copper ferrocyanide. In the case of arsenious sulphide, however, on subjecting the sol to dialysis, the cataphoretic speed first decreases and reaches a minimum, then increases and reaches a maximum and afterwards again decreases. The sol was so prepared that it did not contain initially any free arsenious acid. The dialysis was carried out in a dark place to avoid effect of light on the sol. On analysing the various samples of the sol used in cataphoretic speed determinations, it was found that the amount of arsenious acid increased with the progress of dialysis till the cataphoretic speed decreased; after the minimum value of cataphoretic speed was reached the amount of arsenious acid began to decrease, apparently due to further hydrolysis stopping and arsenious acid passing out in the dialysate. S. N. Mukherjee‡ has observed that the cataphoretic speed of arsenious sulphide decreases on the addition of arsenious oxide to the sol. The initial decrease in the cataphoretic speed with an increase in the amount of arsenious acid due to hydrolysis of the sol noticed by us therefore agrees with the observations of S. N. Mukherjee. The subsequent increase in the cataphoretic speed may be due to a decrease in the amount of arsenious acid as well as the peptising sulphid-ions and hydrosulphid-ions and the final decrease due to a considerable decrease in the amount of the peptising ions. Detailed results will be published elsewhere in due course.

B. N. DESAI.
Physical Chemistry Laboratory,
Wilson College,
Bombay 7,
May 11, 1934.

* Desai, Nabar and Barve, *J. Ind. Chem. Soc.*, **9**, 463, 1932; Desai and Borkar, *Trans. Faraday Soc.*, **29**, 1269, 1933; and B. N. Desai and A. K. Desai, *ibid.*, **30**, 265, 1934.

† S. G. Chaudhury, *J. Ind. Chem. Soc.*, **10**, 431, 1933.

‡ S. N. Mukherjee, *Kolloid Z.*, **53**, 159, 1930.

Development of Vertebral Column in Fishes.

PROF. MACBRIDE[1] reviewing my work[2] on the "Development of the Vertebral Column in Fish" expressed a doubt as to the correctness of my view in regard to the origin of the zygapophyses in the fish. He wrote: "Ramanujam describes these (the zygapophyses) as vertical outgrowths of the 'outer

[1] MacBride, E. W, "Recent Work on the Development of the Vertebral Column," *Biological Reviews*, Cambridge, **VII**, 1932, pp. 108-148.

[2] Ramanujam, S. G. M., "The Study of the Development of the Vertebral Column in Teleosts, etc.," *Proc. Zool. Soc.*, 1929, pp. 365-414.

bony ring', *i.e.*, the perichordal centra 'formed directly from connective tissue' and later he states that the basi-dorsals of each segment is connected with its zygapophyses by a 'bony ridge'. The whole matter requires re-examination and restatement. The strong probability is that Ramanujam is mistaken as to the origin of the zygapophyses. If, as seems probable, they are formed as extensions of the supra-dorsals then these pieces will correspond to the so-called 'dorsal inter-dorsals' of the higher forms." ([1]pp. 120-121.)

A re-examination of my preparations only served to confirm me in my views. I was therefore glad to receive a communication a little later from Prof. MacBride confirming my view. As it is of zoological interest, I give below the relevant portion of his letter:

> "We have found that you are quite right about the zygapophyses which you described as outgrowths from the centra. This is true and in my judgment these outgrowths are the missing intercalaria. They have nothing whatever to do with the zygapophyses of the higher forms which are outgrowths from the arches and correspond to what Prof. Piiper called the dorsal inter-dorsals. This is a remarkable example of parallel evolution and one which I did not expect to find."

I am afraid I have also to adhere to my view that the paired cartilages adhering to the inner sides of the basi-dorsals and supporting the dorsal longitudinal ligament are probably equivalent to the supradorsals of other forms, a view which Prof. MacBride regards as requiring further investigation. ([1]p. 120.) Their unusual position has naturally given room to some scepticism as to the correctness of my view. This unusual position is due to the enormous development, dorsal to the spinal cord, of a longitudinal ligament which is rarely so well developed, if at all, in most other forms. This has necessitated a structure to separate and protect the spinal cord from the dorsal longitudinal ligament. This need has been met by the supradorsals which in higher forms form the neural spine being shifted to a more ventral position and the basidorsals themselves being continued up, instead, to form the spine. The supra-dorsals shifted to a more ventral position still form the roof—a protecting roof—for the soft spinal cord as in other and higher forms. At the same time, they serve as props on which the enormously developed ligament rests. The supra-dorsals which in higher forms, *e.g.*, Amphibia, are single and median retain here in *Clupea* the primitive paired condition. It will be noted that the neural cavity which in most forms is single is here in *Clupea* divided into two channels—an upper vertebral channel enclosing the ligament and a lower larger canal enclosing the spinal cord—by the development of these paired cartilages inner to the basi-dorsals and at the level between the ligament and the spinal cord.

More recently, Mookerjee[3] has sought to question the accuracy of my observations on the development of the intervertebral ligament, as they do not coincide with his observations in *Ophiocephalus*. *Ophiocephalus* is a specialised form and as I pointed out at the commencement of my paper,[2] the interest of my investigation lay in the fact that I took a generalised form which naturally has shown conditions more primitive and of phylogenetic importance than the work of previous authors which, like Mookerjee's observations now on *Ophiocephalus* were all on specialised forms which have "relatively large eggs and shortened development[1]".

S. G. MANAVALA RAMANUJAM.

Department of Zoology,
Presidency College,
Madras,
May 14, 1934.

Vitamin B_2 and a New Flavin in Ox-Kidney Extracts.

DURING recent years we have been trying to get a highly concentrated preparation of Vitamin B_2 from ox-liver and ox-kidney.* Meanwhile, R. Kuhn *et al*† (*cf.* also Ellinger and Koschara‡) have succeeded in the isolation of two water-soluble, crystalline pigments, which they have termed ovoflavin and lactoflavin, from egg-white and whey respectively. These are yellow-red substances, exhibiting strong green fluorescence in aqueous and acid solutions and are said to be the most active preparations of Vitamin

[3] Mookerjee, H. K., "On the Development of the Intervertebral Ligament in Teleostean Fishes," *Curr. Sci.*, pp. 342-343, 1934.

* Guha, *Biochem. J.*, **25**, 945, 1931; Guha and Chakravorty, *Ind. J. Med. Res.*, **21**, 211, 1932; Guha and Chakravorty, *J. Ind. Chem. Soc.*, **11**, 295, 1934.

† *Ber.*, **66B**, 576, 1034, 1950 (1933).

‡ *Ber.*, **66B**, 808, 1933.

B_2 so far recorded. K. G. Stern§ has also obtained a similar pigment, hepatoflavin, from horse-liver. These pigments, termed "flavins" by Kuhn, apparently belong to a group of water-soluble natural colouring matters called lyochromes (Ellinger).

Starting from a concentrated aqueous extract of ox-kidney (50 kg.), and following approximately the methods of Kuhn—by adsorbing on Fuller's earth in acid solution, eluting with a mixture of pyridine, methanol and water, purifying with picric acid and further over silver salt—we have obtained a yellow-red hygroscopic solid showing strong green fluorescence in aqueous and acid solutions. An impure fraction of the substance at the final stage produced good growth in young Vitamin B_2-deficient rats in daily doses of 0·2 to 0·3 mg. One of these concentrated fractions of Vitamin B_2, when dried in the vacuum desiccator and placed under the microscope, was found to consist in large part of yellow-coloured prismatic needles. Considerable difficulty was experienced in the preparation of the pure substance owing to its sensitiveness to light. This crystalline substance apparently belongs to the lyochrome group of pigments and may be called "Renoflavin". Its relation to the other flavins and to Vitamin B_2 is under investigation.

B. C. GUHA.
H. G. BISWAS.

Biochemical Laboratory,
Bengal Chemical and Pharmaceutical Works, Ltd., Calcutta,
May 22, 1934.

§ *Nature*, **132**, 784, 1933.

Diamagnetism and Molecular Association in Organic Liquids.

THERE are many important problems connected with the diamagnetism of liquids which need satisfactory solutions. One of these is the question whether molecular association in organic liquids affects the diamagnetic susceptibility.

Although several investigators[1] have observed variations from the additive law in the case of organic liquid mixtures, it has been consistently found in this laboratory that no such variations exist. Rao and Sivaramakrishnan[2] using a Curie balance observed that the additive law was obeyed to within ½%. More recently one of us (S. R. R.) repeated the measurements with great care using a new method in which a combination of the Guoy and the Curie methods was adopted and in which the volume susceptibilities were directly compared. It was found that the mixtures followed the additive law to within ⅕%. Kido[3] has recorded similar observations and shown that variations occur only when a change in the nature of the carbon link takes place in the molecules concerned.

If there is a genuine variation from the additive law in the case of mixtures of acetone-chloroform and acetone-nitrobenzene and if this variation is due to a gradual break-up of association caused by the presence of the foreign molecules, temperature variations should profoundly affect the departures from the additive law. One of us (P. S. V.) has investigated the diamagnetism of typical organic liquid mixtures by the Quincke method at different temperatures ranging from 15°C. to about 75°C. It was found that the mixtures of acetone-chloroform and acetone-nitrobenzene gave straight line graphs between the specific susceptibility and concentration at different temperatures. The diamagnetic susceptibility of nitrobenzene showed no variation as its temperature was raised, a result which accords well with that of Cabrera and Fahlenbrach,[4] but which disagrees with the observations of Mathur[5] and Rao and Sriraman.[6] The new investigations were made at fields (25,000 gauss) much higher than those used by them. The meniscus conditions and the corrections involved were carefully studied theoretically and experimentally. These corrections appear to become very large at low field strengths and give rise to spurious variations. The X-ray diffraction studies of Todd[7] on nitrobenzene at different temperatures lend confirmation to these observations.

There is one other point in this connection which needs some elucidation. Some investigators have mentioned that in the case of mixtures of organic liquids whose molecules have large electric moments the mutual influence caused by neighbouring

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[1] For full details of previous literature see *Ind. Jour. Phys.*, **7**, 393, 1932.
[2] *Ind. Jour. Phys.*, **6**, 509, 1932.
[3] *Sci. Rep. Tok. Imp. Univ.*, **21**, pp. 149, 288 and 869, 1932.
[4] *Zeits. f. Phys.*, **85**, 568, 1933.
[5] *Ind. Jour. Phys.*, **6**, 207, 1931.
[6] *Ind. Jour. Phys.*, **8**, 315, 1934.
[7] *Phys. Rev.*, **44**, 794, 1933.

fields may alter the diamagnetic susceptibility. It is difficult to see how this could happen. Such an argument is not tenable since it can be shown that change of state from liquid to vapour does not produce any large change in the susceptibility value. Vaidhianathan's[8] results apparently show some such variations in the case of certain liquids but our calculations indicate definitely that if instead of assuming that a volume of 22·24 litres of the saturated vapour at N.T.P. has the molecular mass (an obviously untenable assumption in the case of saturated vapours), we directly calculate the specific susceptibility from the density data of the saturated vapour (taken from the tables) the liquid and the vapour values agree to within the limits of experimental error. We have also in progress investigations on the diamagnetism of vapours based on the methods developed in this laboratory to test these conclusions rigorously. If therefore change of state from liquid to vapour does not produce any appreciable change in the susceptibility value, it follows that at least in magnetic measurements of this kind, the mutual influence of molecular electric moments is negligible. These considerations along with those outlined at the beginning show clearly that any variation from the additive law in organic liquid mixtures is highly improbable and that association does not affect the specific diamagnetic susceptibility in the case of organic liquids.

Full details are being published elsewhere.

S. RAMACHANDRA RAO.
P. S. VARADACHARI.

Annamalai University,
Annamalainagar,
May 24, 1934.

[8] *Ind. Jour. Phys.*, **2**, 135, 1927.

Photo-Dissociation of the NO_3^- Ion and its Dependence on the Polarisation of the Exciting Light-Quantum.

AQUEOUS solutions of several nitrates have been studied for their absorption spectra in the ultra-violet. They all show two absorption bands, one feeble extending from 350 $m\mu$ to 270 $m\mu$ with a maximum at 300 $m\mu$, and a second absorption which is very much stronger, beginning at about 230 $m\mu$ and having its maximum at 206 $m\mu$[1]. Following the explanation given by Henri and his collaborators[2] for the absorption spectra of NO_2, SO_2, CS_2 and other molecules, and of Dutta[3] for SO_3 and N_2O_5 we may attribute the origin of the two absorption bands of the NO_3^- ion to the following photo-chemical reactions. The absorption which begins at 350 $m\mu$ may be taken to correspond to the photo-dissociation of the NO_3^- ion into NO_2^- ion and oxygen atom in the ground state ($^3P_2$) according to the relation

$NO_3^- \rightarrow NO_2^- + O(^3P_2) - 81$ K cals. (350 $m\mu$). (1)

From thermochemical data[4] we have

$NO_3^- \rightarrow NO_2^- + \frac{1}{2}O_2 - 24$ K cals. .. (2)

From (1) and (2) we obtain

$\frac{1}{2}O_2 \rightarrow O(^3P_2) - 57$ K cals. .. .. (3)

which gives for the energy of dissociation of the O_2 molecule into two unexcited O atoms, the value 114 K cals. This agrees with the value 114·6 K cals. recently obtained by Henri[2] from the predissociation limit of NO_2.

The second absorption band, which begins at about 230 $m\mu$, may be taken to correspond to the dissociation of NO_3^- into NO_2^- and an *excited* O atom according to the relation

$NO_3^- \rightarrow NO_2^- + O(^1D_2) - 124$ K cals. (230 $m\mu$). (4)

From (4) and (1) we obtain

$O(^1D_2) - O(^3P_2) = 43$ K cals. .. (5)

This again agrees with the value 45·1 K cals. obtained from spectroscopic measurements by Frerichs, Hopfield and Paschen.[5]

The photodissociation due to the 206 $m\mu$ absorption band is confirmed by the direct experiments on KNO_3 solutions by Warburg[6] and others; a feeble effect has also been claimed with sun-light having

[1] For a typical absorption curve for the nitrate solutions see Fig. 1. Maslakowez, *Zeits. Phys.*, **51**, p. 703, 1928; Fig. 2. The values given in the present letter for the wave-lengths corresponding to the beginnings of the two absorption bands and their maxima, are taken from this curve of Maslakowez.

[2] See article on "Pre-dissociation" by V. Henri, *Leipziger Vortrage*, 1931, English translation, Blackie, pp. 121-143.

[3] *Roy. Soc. Proc.*, A., **137**, p. 366 and **139**, p. 397, 1932.

[4] *Int. Crit. Tables*, **5**, p. 178.

[5] See Bacher and Goudsmit, *Atomic Energy States*, p. 333. The term values for the $^3P_2$ and $^1D_2$ levels are 109,837 and 93,969 cm^{-1}, so that their difference is equal to 15,868 cm^{-1} or 45·1 K. cal.

[6] *Sitz. Ber. Berliner Akad.*, 1918, p. 1242.

SUPPLEMENT TO "CURRENT SCIENCE".

Reviews.

THE CONTINENT OF ASIA. By Lionel W. Lyde. (Macmillan & Co., Ltd., St. Martin's Street, London. xxii+747 pp. 1933.) Price 16*s*. nett.

It is difficult to say which is more difficult, either to write a book of this magnitude and importance or to read it. Prof. Lyde has a continental mind. He took five years to get a mental picture of Europe, then set to work on South America, North America, Africa in succession and finally spent twelve years to visualise before his mind the picture of Asia. His mental picture is "easy, simple and true" and the weight of information is no burden on his memory. If an author of the mental calibre of Lyde's requires twelve years of hard study and investigation to get a complete mastery over the details of a single continent, what about the immature students sitting for the University examinations being required to exhibit an equally intimate and detailed knowledge of *all* the continents of the world at the end of two or three years' study? Here is a clear illustration of the fundamental principle of education, *viz.*, that knowledge implies an evolutionary process extended over a prolonged period of time and cannot be compressed by the University hydraulic machinery.

The book is certainly classic in substance and form. The style is literary and engaging. The illustrations are excellent and adequate. The arrangement of topics is easy and logical. The information is bewildering in the mass, and satisfies even a gargantuan appetite. To be able to write a fascinating book of this description on the biggest continent which presents the most complex varieties of physical features, climatic conditions, natural products and ethnic differences, implies a mental equipment of the highest order. We have nothing but praise for the author and his great work.

The book is divided into two parts. The first part which deals with the physical relations of the different geographical units of Asia with one another and of the whole continent with the globe together with the general description of its orography, almost impinges on the domain of Geology. The chapters on "Climate" form a brilliant essay on meteorological studies which are considered under three fundamental factors, *viz.*, size and distribution of land and water areas, the relation of area to the latitude and highland core, which rises steadily in latitude from the South-West to North-East of the continent between the Ægean Sea and Bering Strait. The problem of the climate of this vast land mass which is nearly one-third of earth's surface, must be a world problem, the different aspects of which are marshalled and presented in a cogent and assimilable form. The principles and factors involved in climatological studies are scientific and therefore the general laws and their applications naturally appeal to minds possessing even a moderate scientific training. The chapters on the flora and fauna discuss the problem of their origin, environment, distribution and endemic forms in a manner that they would form excellent sections of works on Botany and Zoology. The next chapter on "Man" is a condensed summary of our ethnological and anthropological knowledge of the diverse races inhabiting Asia, with due emphasis on the human and political note of all the amazing differentiations. The first part concludes with a brilliant dissertation on Geographic "Controls" under which most of the facts and factors dealt with in the previous chapters are reviewed. The word "Control" need not imply determinist causation, but really connotes the tendency of certain geographical conditions to evoke or frustrate human actions and reactions: the social polity, the racial characteristics, the industries and occupations in relation to the fertility of the soil and natural deposits of mineral wealth, the influence of communications and transport and the effect of human contacts afford excellent and stimulating reading.

The regional geography of Asia which occupies the greater part of the book must in the nature of things follow the usual plan of geographical works, setting forth the details of provinces in their physical and ethnic features as well as their social, political, moral and material advancement. The second part is encyclopædic: and each

chapter bears the impress of a critical insight and scientific temper which distinguish Prof. Lyde's works.

A few errors, possibly through oversight, have crept in. In the chapter on "Natural Faunas" on page 163, the following sentence occurs:—"And if our description of the Tundra was sufficiently complete and pertinent, we may expect a more or less 'amphibious' fauna, even if true amphibians —like reptiles—are absent." If the word "like" in this sentence means "of the same kind" then the classification is clearly wrong. On page 468, in the description of the Cauvery Basin, we read, "Behind this, perhaps, is the solid fact that the river winds down from its Coorg heights (5,000 ft.) in densely forested ravines, and even in Mysore flows often in deep rocky glens, where evaporation and population are alike at a minimum. A good deal of water is taken from it in Mysore by a dozen anicuts specially by the famous 'Madadhatte Channel' which lights Mysore city and irrigates the 70 odd miles between that and Seringapatam." Obviously there is some confusion here. A few of the old anicuts have been submerged in the famous Krishna Rajendra Sagara Works and there is no such channel as "Madadhatte". If this is "Meke Dhat" then the power that lights Mysore does not come from this area, but from Sivasamudram and the river which debouches between two rocks at Kankanhalli, is unfit for irrigation purposes; the only channel which is 76 miles long but does not irrigate 70 miles of land is Chikka Devaraya Sagara Channel. Again on page 465, one of the peaks of the Nilgiris is called "Makrati" and the whole poetry attached to this romantic hill called "Mukarthi" is robbed by the license in spelling. Space forbids mention of a few other errors. None of these are of great account. In spite of these trifling blemishes, the book is a notable achievement of a great mind.

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THE METHOD AND THEORY OF ETHNOLOGY: An Essay in Criticism. By Paul Radin. (McGraw-Hill Book Company, Inc., New York and London. xiii+267 pp. 1933.) Price 15*s.* nett.

Within the last few years there have been several contributions on the method of Ethnology and this fact might seem to denote that this branch of knowledge has arrived at a stage when ethnologists are prepared to look back upon their past achievements with critical objectivity and to devise methods of investigation and correlation of data for the purpose of brigading Ethnology under the ranks of exact sciences. The power of deducing general conclusions capable of wide application is not the sole attribute of science and knowledge grows not so much by theories and hypotheses as by the accumulation of careful and correct observation of facts and their faithful documentation; the correlation of data under specific and related categories and the elimination of error, exaggeration and prejudice. Any systematised effort to gain new knowledge is as much entitled to be called research as the most elaborate experimental arrangement for investigation of physical problems. Most of the Biological sciences should devote greater attention to the collection of facts by trained observers endowed with the faculty of self-criticism, unhampered by discussions of methodology and theories. The study of racial culture of primitive tribes, their social organisation, customs, manners, religions, superstitions, beliefs and practices, offers a wide field for the play of personal temperament, special interests and prejudices of particular schools of thought; and in the eagerness to establish any preconceived theory, we are apt to miss the fundamental object of enquiry, *viz.*, to obtain a complete and authoritative account of everything pertaining to aboriginal tribes. According to Paul Radin, we have to distinguish between the attitude and interpretation of the ethnologists and it not infrequently happens that what the ethnologist calls interpretation of aboriginal culture is really his attitude towards the study as is often evidenced by his mode of describing or discussing the subject. The book stresses the difference between these two modes of approach and points out its importance in the investigation of racial problems.

The aboriginal people may be studied from the standpoint that they occupy a lower scale in evolution and therefore, their organisation must be inferior to our own. According to this view, their customs, manners and culture must have phylogenetic significance and the culture of civilised nations must be so many offshoots, having their roots in the aboriginal races. Among those who hold the evolutionary concept of cultures may be mentioned Thurnwald, Durkheim, Rivers, Haddon and Radcliffe-Brown.

The attitude of Boas and his school is that nothing can be predicted of a given culture, but its specific character is first to be determined. No general conclusion can or should be drawn before a large number of cases are carefully investigated and their specific affinity is demonstrated. A classification of cultures into classes, families, genera and species on the basis of biological classification of living organisms, would come nearest to expressing the truth of Ethnological studies. This is the quantitative treatment of culture.

The third attitude which is really the attitude of the author represents that the study of racial cultures has the purpose of being a specific and comprehensive statement of the subject. The book is a scholarly exposition of this basic viewpoint. The data of Ethnology,—culture traits, culture areas and culture centres,—do not use themselves to be treated as those of biology or physics. It is true that most authors may not agree with this view.

The book purports to be an essay in criticism of the theory and method of Ethnology. It really represents a disinterested endeavour to examine and make known the best in Ethnological literature.

* * *

THE CAUSES OF WAR. By Sir Arthur Salter, Sir J. A. Thomson and others, with an Introduction by Ruth Crauston. Edited by Arthur Porritt. (MacMillan & Co., Ltd., St. Martin's Street, London. xv+231 pp. 1932.) Price 7*s*. 6*d*.

The book is the outcome of the deliberations of one of the four International Commissions organised by the Executive Committee of the World Conference for Internal Peace through Religion and the members of the Commission whose contributions are embodied in the book are distinguished alike for their public service and peaceful temperament. The reports prepared by competent authorities on economic, industrial, commercial, racial, political and cultural causes which produce armed conflict between nations or groups of nations, are set forth in great detail and chapters dealing with the secondary contributions made by such agencies as Science and the Press make the book a self-contained unit.

The great merit of the book is that it has not the flavour of official reports, and is therefore eminently enjoyable. The information is full and authoritative. The arrangement of matter leaves little to be desired. Making allowance for individual differences, the style of presentation is masculine and crisp. The causes which lead to open hostilities are examined in a thoroughly critical and dispassionate spirit. After the book is read, the effect produced is peace-mindedness and so long as the effect lasts, you seem to belong to a different world.

Before 1914 when Europe was literally dying for war, any trivial cause might have —as it did—provoked a universal conflagration, but since 1919, Europe is unable to embark on the enterprises which between the years 1914—1918, seemed to engulf civilisation. However willing any nation may be to repeat and improve upon the atrocities of the Great War, the possibility is rendered remote by two factors, *viz.*, war debts and war weariness. Moreover while in the past history of mankind any single cause such as dynastic disputes, religious fanatism or homicidal mania of a despot, might have led to devastating wars, the present-day international relationship of civilised communities will take a great deal of provocation, preferring to expend it all in diplomatic despatches, to making it the basis of armed conflict. The cases in which Governments intervene refer to population problems and colonial establishments and economic policy including trade and industrial relationship and religion has practically ceased to be an active force in producing breach of international peace. The first two groups of causes or affronts may be summed up in one word "Imperialism" which under the pretext of protecting the superiority of one's culture and the purity of racial organisation, forming the root of national arrogance, must in its dynamic phase, involve violence and warfare. Imperialism is a recrudescence of the age-old theory of might, whether in the field of culture, politics or economics. The two fangs of imperialism are oppression and exploitation and the poison that flows through them is pride and aggrandisement: the power which stimulates the latter and causes the former to strike is "Civilisation".

By civilisation, we mean the external embellishments of life with all their deranged balance of wealth, unequal means of employment and lop-sidedness of society. Unlike beauty, civilisation is not even skin-deep. It has not touched the mind. The mind stuff has practically remained the same as when it first emerged from some remote age-like ancestor. A cultured mind is one

that has grown by accretion of knowledge, but is not one that has undergone any fundamental transformation either in essence or in structure. The humanising influence of religion and morality has not altered it as was evident on the fateful fields of Flanders in 1914 and all the churches in the World were unable to prevent the colossal struggle. The fact is that religion as symbolised by modern civilisation comes very much through the head of man but not directly from the heart. The fierce economic competition and the desire to possess all the wealth of the world exclusively have chloroformed religion and the theory that all is fair in Love and War has deadened allegiance to ethical principles.

Is it not a fact that in the background of the public mind of Europe, there is a wild confusion of cross currents of a medley of problems which prevent the nations from agreeing to any proposals of disarmament, economic reconstruction and promotion of general co-operation for the establishment of peace and harmony? Are we peace-minded? We can conceive of no human power the invocation of which will usher a new heaven on earth, except the determination of any one of the single major powers of Europe to disarm totally and absolutely. Every weapon of offence should be destroyed and the Bishop of London who in the course of the Debate on the motion of Lord Dawson's Bill for its second reading to restrict the sale of contraceptives, declared that he would like to make a bonfire of them and dance round it, might more fittingly have wished for a bonfire of all the engines of destruction and lead a merry dance of all the Bishops of Great Britain. We know that it is utterly futile to suggest total and absolute disarmament, and the exclusion of anything of human manufacture that will slaughter. But suppose Great Britain were to do it. What will be the effect of such disarmament on the World?

The book is an excellent contribution to the Science of Peace. It represents the wisdom of great minds and worthy of being universally read.

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PAGAN SURVIVALS IN MOHAMMEDAN CIVILISATION. By Edward Westermarck. (Macmillan & Co., Ltd., St. Martin's Street, London. viii + 175 pp. 1933.) Price 8*s*. 6*d*. net.

All superstitions die hard and they are universally distributed. They generally arise in ignorance and fear and hold an unrestricted sway over primitive minds. Their influence in one form or another is evidenced even among highly cultivated societies. There is no religion but has a budget of superstitious faiths.

The book which collates the personal experiences of the author during his sojourn in Morocco is a notable addition to anthropological literature. These studies were first presented in the form of lectures at the University of London. The principal line of argument is devoted to establish the thesis that Islam received its quota of pagan beliefs and practices from the Arab communities amidst which it was born and as it spread in other countries and converted other races, it continued to absorb the alien superstitious faiths. The spread of religion is not unlike the course of a river which gathers the contamination of all the tracts of country through which it flows, while, however, the purity of the waters is to be found only in the mid-stream just in the same way as the cardinal and elevating doctrines of religion are to be met with in the heart of its teachings. The differences and disputes over the tenets of religious communities centre in the polluted parts of the marginal waters used for daily use and so much are the religious doctors accustomed to unwholesomeness that they forget the existence of life-giving waters of the central channel. The numerous affluents which swell the main current bring in a load of muddy superstition with the result that the imbibition of marginal waters becomes intoxicating and accounts for men slaughtering each other in the name of God who is full of peace and love.

The spread of science weakens the influence that superstitions exercise on men's mind and which religion unconsciously tends to promote. In any endeavour for the ascertainment of truth, superstition hampers progress and where truth is revealed without effort its propagation must necessarily rely on magic, myth, miracles, sacrifices and sacerdotalism. Where a fact or a phenomenon is not easily accounted for, religion explains as the work of elves, jinns and other supernatural agenices or the malign influences of evil eyes, spells and charms; but science attributes it to chance by which is meant that we do not know everyone of a very large number of independent facts influencing the result. The spirit of active enquiry promoted by science and the

spirit of passive acceptance enjoined by religion must necessarily make a wide difference in the training and outlook of mind.

Westermarck's exposition of this fundamental difference which distinguishes the primitive and enlightened minds is clear, logical and convincing. Many of the beliefs to which he refers are universal, for instance, the mischievous and malicious intentions of jinns in human affairs, their occurrence in diversified forms, the influence of evil eyes and the potency of curses and the remedies for them all, are common to every country and to every grade of civilisation and where they flourish ideas of propitiation in their multitudinous varieties must naturally spring up; and in course of time, become consolidated into institutions. Thus the establishment of a liaison with the mystic ceremonies of religion becomes easy and natural. It follows that, if there be any power to overcome the unholy influences of beings who live and work in the dark, that power must belong to righteousness and to beings who love light. Religion which relies in some measure on miracles, spells and other potencies for its propagation and does not discourage superstitious faiths and practices, also invents prophylactics and remedies for the malignant influences of evil spirits and men's evil desires. So long as ignorance and ritualistic practices prevail, superstition is bound to exist.

As we read the book, many of the things which are familiar to us from childhood, are brought back to our mind and strangely enough, that as ignorance is homogeneous in the world of mind, its products wherever they occur are identical, only, however, with such local colour as priestcraft might impart. The book is written with clearness and cogency which distinguish the works of Westermarck and is a faithful record of patient and prolonged study, entirely free from exaggeration and hasty inferences. The chief merit of the book is that it narrates universal facts with the precision of a scientific treatise setting forth the facts as they occur.

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INTERNATIONAL ATLAS OF CLOUDS AND OF STATES OF THE SKY. Parts I and II and an abridged edition of Part I for the use of observers. (Published by the International Meteorological Committee, Paris Loffice National Meteorologique.)

It has long been realised that if a careful watch be kept of the sequence and evolution of clouds it provides us with valuable information for the forecasting of weather.

The first attempt at classification of clouds was made by Lamarck in 1802. As his nomenclature was French and as the paper appeared with much unscientific knowledge, the classification received no recognition. In striking contrast, when Luke Howard published next year in the *Philosophical Magazine* a cloud classification, it met with immediate success and has formed the basis of all future classifications. Three main types of clouds Cirrus, Cumulus and Stratus were recognised and all other cloud forms, especially Cirrocumulus and Cirrostratus, were supposed to be derived from the three. Later the genus Stratocumulus was introduced by Kaemtz in 1841. Renou in 1845 redefined Cirrocumulus and Cirrostratus in the way as used at present, and added with appropriate definitions the genera Altocumulus and Altostratus. He also pointed out that the cloud forms were characteristic of the heights where they occur. Poey introduced Fractocumulus and Mammatocumulus.

A great step forward was taken by Hildebrandsson when he applied photography for cloud study. In his book (1879) he reproduced 16 cloud photographs and also introduced the genus Nimbus for low dark clouds from which continuous rain or snow was falling. Hildebrandsson in conjunction with Abercromby published in 1887 a consolidated scheme based on Howard with the modifications from Kaemtz and Renou. Four levels whose mean heights were derived from measurements in Sweden, were assigned to clouds. Sufficient recognition was by this time forthcoming to lead the International Meteorological Conference held at Munich to appoint a sub-committee composed of Hildebrandsson, Riggenbach and Teisserenc de Bort to produce an International Cloud Atlas based on Hildebrandsson and Abercromby's work. The committee had to face great financial difficulties and finally Teisserenc de Bort published the Atlas under his sole responsibility in 1896. This work contained 27 coloured plates with text in French, German and English.

Though the 1896 Atlas systematised to a great extent the knowledge about cloud forms, practical difficulties arose later; new sub-forms had to be introduced, and all countries did not adopt uniform cloud definitions. Also the advance in the knowledge of meteorology and the development of

aviation necessitated a thorough revision of the Atlas. In 1921 Sir Napier Shaw as President of the Committee asked for suggestions on cloud study and his successor wished to embody the suggestions in a new cloud Atlas. A cloud committee with Gen. Delcambre was brought into existence and the scheme put forward by the Committee was approved in 1929 at the Copenhagen meeting of the International Meteorological Conference. It was decided to publish a General Atlas of clouds and states of the sky called Part I, an abridged edition of Part I for the use of observers, and Parts II and III to be devoted to clouds in the tropics and special local clouds. The last two parts were entrusted to Drs. Braak and Bergeron respectively.

The munificence of a Spanish philanthropist M. Rafel Patxot made it possible to publish and place on sale the general cloud atlas and its abridged edition at a very low price. The abridged edition was ready in 1930 in time to meet the needs of the introduction of new meteorological codes formulated at Copenhagen. The General Atlas and the one dealing with tropical clouds have subsequently appeared (1933).

Among the major changes that have been introduced it may be mentioned: the definition of cirrocumulus is restricted to clouds forming part of or evolving from other cirriform clouds; clear distinction is drawn between altocumulus and stratocumulus in that the smallest of the well-defined regularly arranged elements in altocumulus should not be greater than ten times the sun's diameter; and cumulonimbus should have a cirriform top. Instead of the term Nimbus used differently in different countries the genus *Nimbostratus*, formed by the lowering and thickening of an altostratus cloud from which continuous rain or snow may be falling has been substituted.

To give precision to the cloud forms observed from an aeroplane from above a special chapter has been written and has been illustrated by several plates. Another chapter is devoted to the "States of the Sky" giving the progression of cloud forms in a typical depression of the temperate regions.

The get-up and reproduction of the plates deserve great praise and would draw approbation from any artist.

The abridged edition contains 41 out of the 174 plates and the text portion confines itself mostly to the sections needed for a surface observer.

Part II dealing with clouds in the tropics has been undertaken singly by Dr. C. Braak, a former Director of the Batavia Observatory. Most of the original photographs were taken in Dutch East Indies. It is apparent from the text that a comparatively small belt within the neighbourhood of the equator is under consideration. Great stress has properly been laid on the diurnal variation of clouding due to insolation and on the local formations which contrast with the cloud sequence met with in depressions of temperate latitudes. According to Dr. Braak the regular sequence of clouds associated with typical depressions in temperate latitudes does not occur in connection with disturbances in the tropics, but the cloud forms met with are nearly the same in both the regions. While the depressions and cyclones are not as frequent in the whole tropical zone as in the temperate zones, it may not be quite accurate to describe them as rare. Nearly a dozen depressions or cyclones occur in the Bay of Bengal and the Arabian Sea during a year and the greater part of them are formed from May to December. The cloud forms Altostratus and Nimbostratus may become rarer as we approach the equator but they do occasionally occur associated with depressions in tropical India. The decrease in visibility towards the end of dry season would perhaps be of practical importance to aviators. While one may differ in a few places from the opinions of Dr. Braak, one must cordially admit that he has brought together most of the peculiarities of the tropical regions and has shown that similar meteorological phenomena may be accompanied by very different results in the tropical and temperate regions. This by itself would justify the production of part II, which in addition contains a few interesting photographs showing the influence of mountains on clouds.

The reproductions of cloud forms in the tropical atlas cannot be said to have attained the same very high mark as in the General Atlas. But the reason may not be far to seek, because the number of photographs from which choice had to be made was small.

It would be well worth while to collect and publish a similar series of photographs taken in India when circumstances permit it.

S. L. M.

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A TEXT-BOOK OF APPLIED HYDRAULICS. By Herbert Addison. (Chapman & Hall, Ltd., London.) 21*s*. nett.

The author of this volume has succeeded in presenting in a clear and simple style, a comprehensive yet concise summary of the fundamental principles of hydraulics, striking an even balance between theory and practice. The book covers a large field doing justice to every phase.

The aim of the author that the volume should serve as a Text-book for students working for an engineering degree and also as a work of reference for engineers in general is ably achieved. Its theoretical treatment mostly confined to the first part of the book is very suitable for engineering students and the comprehensive and practical character of the second part justifies its recommendation to all engineers who may be interested in or need information concerning present-day hydraulic practice.

The subject-matter ranges from simple principles of hydraulics to a study of pipe systems, control of water in open channels, pumping machinery, hydraulic transmission and performance and construction of hydraulic turbines. A noteworthy and desirable feature of the book is the inclusion of results of experiments of scale models for studying hydraulic problems. There has been a steadily growing confidence placed on the reliability of the indications from laboratory tests of small-scale models leading to efficient designs of large water structures, such as dams, sluiceways, turbines, centrifugal pumps and propeller pumps. A considerable amount of new material made available by recent researches in backwater and standing wave phenomena is also included. Results of experiments are wherever practicable presented in a graphical form which brings home to the student with definiteness and clarity the underlying principles. The use side by side of both Imperial and Metric Units is advantageous to readers used to either system of units: for instance those accustomed to the Imperial Units can readily follow continental technical literature and *vice versa*.

On the whole the book is very well written and must have involved a large amount of labour. The exposition is clear, undoubtedly as a result of the author's several years' experience as a teacher. Needs of the students are met by the worked out examples at the end of the book. In future editions of the book more graded examples for practice might be added at the end of each chapter instead of a single series at the end of the book. Text-books generally tell so little about the principles of hydaulic similitude and principles of dimensional analysis. As in the book under review results from model experiments are copiously quoted, it will be of great value if a chapter be added in future editions treating of the methods of dimensional analysis and their applications as well as the principle of similitude, which have to be thoroughly understood in order to apply the results of experiments on models to structures of large size.

The publisher's work as well as that of the author has been well done. The diagrams are numerous, well drawn and the several photographs representative of modern plant and of the scale models are well chosen and these will greatly assist the student in his comprehension of the text.

The book will serve as a suitable text for engineering students and will be a welcome addition to the reference library of an Engineer.

V. G.

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THE DESIGN AND CONSTRUCTION OF HIGH PRESSURE CHEMICAL PLANT. By Harold Tongue, A.M.I.Mech.E., A.M.I.Chem.E. (Published by Chapman & Hall.) 30*s*. net.

Chemical Engineering is rapidly developing but there are very few books dealing with the Engineering side of the Chemical Industries. The author has spared no pains to collect information and present them in a useful form. In the second chapter he has dealt with high pressure gas compressors. The books on compressors do not generally deal with such high pressure compressors and the author has described only plant manufactured by leading firms in England and Germany to show the trend in the design of such plants, but there are very good plants manufactured in France and Italy. The book would have been more valuable from the point of designers of Chemical plants, if the approximate cost of the plants were given just as they are given in some books dealing with the design of Power-Plants.

In Chapter IV the author deals exhaustively with the design and maintenance of pressure vessels, the only shortcoming being that the kind of paints, etc., that have got to be used to prevent the formation of rust, etc., in the vessels during service and

the method of applying the same has not been dealt with as exhaustively as the rest of the subject. Only a passing reference is made to the scheme recommended by the British Engineering Standards Association, whereas, a large amount of extracts of recent English patents are given at the end of the several chapters.

The subject of autoclaves and the design of pipings, valves, etc., are fully dealt with and also neat drawings of several designs are included. In fact the book is profusely illustrated with neat drawings and photos. In Chapter X, he deals with the construction and manufacture of pressure vessels, and an idea of manufacture of the plant is necessary for the preparation of correct designs, and the author has done well to include a chapter on this subject.

On the whole the book is well written and well illustrated and the author deserves to be congratulated on the production of such a useful book for designers of chemical plants.

E. K. R.

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SOIL ANALYSIS: A Handbook of Physical and Chemical Methods. By C. H. Wright, M.A., F.I.C. (London: Thomas Murby & Co., 1934. vi + 236 pp.) Price 12*s*. 6*d*. net.

There are a few publications such as those of the A. O. A. C. or the Chemists' Year Book which describe many of the better known methods of soil analysis. Some useful particulars are also given in appendices to monographs like those of Russell. The information thus provided is not, however, quite complete and each laboratory is obliged to work out its own methods to suit the local conditions and available equipment. As may be naturally expected, such improvised methods do not share the same degree of accuracy, so there has always been considerable difficulty in comparing results obtained from different laboratories. The present publication which deals with the different routine methods of analysis is, therefore, a welcome contribution, especially to those working in out-stations, far away from the bigger libraries.

The book has presumably been intended to cater to the needs of those who have already had some useful training in soil analysis but wish to have some book of reference for the relevant details. To such workers, as also to those who, though having access to original literature, wish to have only a few details such as strength of reagents or order of treatments, the book will come in very handy. It will also be found useful by those who wish to make a general survey of soil methods. It is rather doubtful, however, if students who are just being initiated into the subject will find it an easy book to follow.

The occasional foot-notes provided by the author supplying further information or offering certain comments based on personal experience are quite useful and one wishes there were many more such notes presenting critical analyses of the different methods. In fact, such comments should form a regular part of the book and follow the description of each method cited in the text. Absence of such details leaves a worker, unused to a particular type of technique, quite at sea, especially when a number of methods are cited. The meagreness of illustrations would be found a handicap by those who wish to set up new apparatuses for work. The omission of theoretical principles would also be felt by many workers who would naturally wish to understand the significance of each step involved in an estimation. Many of the proposed items of procedure may be obscure or unnecessary and an analyst with an original outlook may like to simplify or otherwise improve on them without sacrificing accuracy. The absence of theoretical background would discourage such efforts. It is hoped that the above suggestions would receive the consideration of the author when the text is being prepared for the second edition. The discerning reader will not grudge any extra price that may be levied for the additional matter.

The efforts of the publishers and printers in the preparation of the book deserve much praise. The paper used is of high quality and the printing very neat. The binding is also quite elegant. Considering the quality of the matter and the get-up, the price is not too high.

V. S.

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PFLANZENCHEMIE UND PFLANZENVERWANDTSCHAFT. By Dr. Hans Molisch. (Gustav Fischer, Jena, 1933.)

Dr. Hans Molisch, Professor and Director of Plant Physiological Institute in the University of Wien, has brought out an attractive volume on Plant Chemistry and Plant relationships which aims at showing the importance of plant chemistry in understanding the relationships of plants with one another. Just as the knowledge of

external and internal morphology is indispensable for the systematic classification of plants so also is the knowledge of Phytochemistry helpful towards the same end. He has shown the connection between chemistry and plant affinities by pointing out the presence of specific substances in the same race, in the different races of the same genus, in different genera of the same family and in more or less related families. He has supported his views by taking evidence from the chemical differences between male and female plants like the positive and negative strains of Mucorales, from the transplantation experiments and the various reactions by the application of serological methods.

According to the author the chemical substances present in the cells and the various reactions they set up, influence the shape and form of the tissues and organs of the whole plant. It is now felt that the genes which determine the morphological characters of organisms are also responsible for biochemical differences between them and consequently all the differences that distinguish one species from another can be traced to the differences in the genes.

F. F. Blackman (1921) in a thought-provoking contribution tried to show that the chemistry of carbohydrate production in plants can be used for the biochemical classification of plants and for deciding their systematic relationships. This important contribution unfortunately is not mentioned by the author as it certainly, in a way, supports the author's conclusions. It is true that the biochemical differences and resemblances may help us in deciding plant relationships in some cases the present state of our knowledge of the chemistry of the cells and diversity and complexity of the chemical reactions occurring in it should make us extremely cautious in making it our guide, in studying natural relationships. The book is extremely well written and will be a useful guide to those who are interested in plant chemistry.

R. H. D.

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QUALITATIVE CHEMICAL ANALYSIS. By Roy K. McAlpine and Byron A. Soule. (Chapman & Hall, Ltd., London, 1933. xii+696 pp.) Price 21*s*.

The student of chemistry interested in qualitative analysis looks for at least two principal features in any text-book: (i) a sound theoretical treatment of the principles underlying analysis, and (2) the arrangement of the material in an accessible way for reference, the analytical procedure being described with reasonable fullness. The present publication satisfies these two requirements to a generous degree.

Text-books on qualitative analysis are by no means rare; but only a few of them are popular. One such is that by A. B. Prescott and O. C. Johnson, published nearly two decades ago, and to-day out of date. The present publication while retaining the merits of a book which had stood the test of time has been considerably enlarged so as to incorporate the more recent developments in this branch of chemistry and improved so as to emphasise and, or, elaborate these aspects which the users of the classical text-book demanded. Analytical chemistry is no more to be looked upon as an art which needs to be perfected by practice; it has emerged out as a science based on well-established laws governing reversible reactions and ionization, and an adequate treatment of the theory is to-day a necessity for an intelligent understanding of the procedure which the chemist practises in the laboratory. It may be said, without hesitation, that the neglect of the theoretical background has been mainly responsible for rendering qualitative analysis a bug-bear to the University student. The authors have sought to remedy this defect, and the first 150 pages of the book are devoted to a lucid exposition of the principles an understanding of which will provide the master key for unlocking the complexities of the procedures described in the succeeding 400 pages.

The book contains much more matter than is envisaged by the title. Details pertaining to preparation and properties of elements ordinarily treated in text-books of inorganic chemistry, are given. This is perhaps superfluous in a book on qualitative analysis. The description of physical properties such as solubility of important salts and reactions of the elements are, however, relevant. Copious references to literature are provided, a feature of obvious importance to the progressive chemist, and a very useful appendix including among others, tables of solubilities, reduction potentials and atomic weights, gives a fair amount of supplementary information. The more usual tabular statements concerning the detection and characterisation of the individuals of the different analytical groups, will be found

invaluable for reference during laboratory work.

The procedures described have been tested out and the student is advised to use 15 c.c. of solution containing 20 to 100 mg. of substance for his tests. While more concentrated solutions can be diluted to conform to the specifications and the procedure followed, very often the usual method will be found to be untenable when only minute quantities of substances are available. Recourse must be had to more sensitive tests. A chapter on micro methods would have greatly added to the value of the work. These methods which are of comparatively recent development are extremely sensitive, often specific and allow of rapid examination; great advances have been achieved in the use of organic reagents, forming co-ordinate compounds with metals which are more or less stable and often either highly coloured or sparingly soluble. It appears most desirable that the University student should be initiated into the methods of microchemistry early in his career and an adequate treatment of this aspect of analytical chemistry should be included in any text-book. We hope that this omission would be remedied in the next edition.

We welcome this excellent work embodying "principles and methods used in identifying inorganic substances together with a systematic survey of the chemistry of these substances" and recommend it to the University student, who will find it useful not only during his College course, but also later in his career as a chemist. It deserves a place in every reference library.

N. S.

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FLUORESCENCE ANALYSIS IN ULTRAVIOLET LIGHT. By J. A. Radley and J. Grant. xi+219 pp. (Chapman & Hall, London, 1933.)

For the success of the chemist whose activities cover a very wide range of subjects—from forensic medicine to agriculture—what is perhaps most essential to-day, is a bold departure from the traditional methods of analysis and synthesis and an attempt to invoke the aid of new technique for his investigations. This is particularly true in the field of Applied Chemistry where by employing new tools for his work, the Chemist either succeeds in throwing fresh light on many complex problems or in independently confirming the results indicated by other methods.

The book under review is an attempt to bring between the covers of a handy volume a very large number of stray observations concerning the use of fluorescence methods for analytical purposes. The publication brings home to the chemist the most modern developments in the subject and constitutes an eloquent appeal for a more intensive and extensive research on the application of fluorescence methods to specific problems.

The Second Part of the Volume dealing with the applications contains 19 chapters. The theory and technique has been adequately dealt with in the first 55 pages and any one who takes to the subject anew will find from the descriptions the necessary practical details. He will also be able to know the pitfalls he has to avoid in the application of the technique. The subject-matter in the second part takes the form of a catalogue of observations by various workers. Perhaps this is inevitable while dealing with a subject comparatively recent and a large number of workers have applied the methods to a variety of problems without an adequate investigation of the theoretical aspects. Many of the results achieved are only of a qualitative nature, but obviously the subject is still in its infancy and has yet to grow. We are surprised to find in the book no more than a mere mention of "Fluoremetry", a new method of micro analysis which should prove exceedingly useful in the estimation of substances which are either fluorescent themselves or become so after addition of suitable reagents, but which do not lend themselves to determination by either Colorimetry or Nephelometry.

The book is perhaps the first of its kind in the English language and should command the appreciation of a large number of chemists, who will find in its pages the description and application of a new tool which may be used with profit for the solution of their own specific problems.

N. S.

* * *

ORGANIC SYNTHESES. Vol. XIV. Edited by W. W. Hartman. (Chapman & Hall, Ltd., London, 1934.) Price 10*s*. 6*d*.

Organic Syntheses is an annual publication of complete detailed directions for the preparation of some organic chemicals taken at random. The first of the series of which the present one is the 14th member, appeared in 1921. In the year 1932 a collective volume

incorporating all the preparations described in the previous nine individual volumes was published wherein various indices, *e.g.*, Reaction index, compound index and formula index, going a long way to help the worker in finding out the right thing he wants, had been introduced. The publication of these pamphlets will act as a boon, though in a restricted sense, to the organic researchers. If fortunately, the preparation one wants happens to be described in any of these publications, he is immediately in possession of the very best authoritative method and is thus saved the trouble of experimentation to find out the exact conditions necessary for securing a good yield of the desired product. While realising the stupendous and apparently unending nature of this task, it has to be remarked that the number of preparations described annually are infinitesimally small to cope with the need of the workers.

The classification of the details of each preparation into three sections, namely, (1) Procedure, (2) Notes, and (3) Other Methods of Preparation, is commendable indeed. But in the section 'Procedure' the insertion of too many minor details sometimes approaches very nearly to unnecessary repetition and spoon-feeding which might stand in the way of proper development of imaginative and creative faculty of the researchers. The second section 'Notes' is really a very useful portion as it strikes a note of warning about the pit-falls in the preparation. Section 3, *i.e.*, Methods of Preparation, though not an exhaustive review of the literature, gives in brief the other alternative methods being particularly useful for those to whom Beilstein and other reference books are inaccessible.

Talking about the present volume, the printing and get-up are as excellent as in the previous ones. In view of the expected collective volumes to appear periodically, such an elaborate get-up is perhaps unnecessary. It is not necessary to be so lavish with the pages as in the present and also in most of the preceding volumes. Out of the 92 pages describing 26 preparations, more than 22 pages are left untarnished by printer's ink. Again, the structural formulæ always take up space and in a practical book of this nature their number may be lessened. On page 30 of the volume under review three formulæ are written twice each, which repetition could have been avoided by insertion of arrow-heads only. The price of the book which is so high as 10 *sh.* 6*d.* net could perhaps be brought down by paying a little more heed to these points.

There is no one particular system followed in selecting the preparations. They have been gathered at random, collected together in a volume and printed. Such a haphazard mode of collection is open to the possibility of missing important and commonly needed preparations. It may be suggested, therefore, if instead of this present procedure, a systematic undertaking of a set series of preparations representing various types of reactions is programmed, as is done in Houben-Weyl's book, one can at least visualise the limit of the work, even which may not be near. Such a systematic undertaking of preparations will be of greater help to the researchers than at present.

On the whole, the series of publications is of great help and can whole-heartedly be recommended for use to the advanced organic researchers.

P. C. GUHA.

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THE FLATFISHES OR HETEROSOMATA: A Systematic Monograph of the Flatfishes (Heterosomata). Vol. I. Psettodidæ, Bothidæ, Pleuronectidæ. Pp. viii + 459, figs. 317. By J. R. Norman. (Printed by order of the Trustees of the British Museum, London, 1934.)

The Flatfishes or Heterosomata are characterised by their greatly compressed body and by their remarkable departure in general symmetry from the usual bilateral shape characteristic of the majority of vertebrate animals. To an average zoologist, they are known as fishes with both the eyes on the same side of the head. The evolutionary steps by which this asymmetry "has been brought about in the natural history of the group, and the ontogenetic modifications by which it is brought about in the history of the individual, have been extensively discussed and described without the interest of the facts having been exhausted, and possibly without all the facts themselves having been brought to light". In recent years considerable attention has been paid to the ecology, bionomics, evolution and anatomy of these fishes, but the starting point for all these investigations has to be an accurate knowledge of the systematics of the group. This was supplied by Günther in 1862 in the fourth volume of his *Catalogue of Fishes in the British Museum*, but since

then no attempt has been made at a comprehensive systematic revision of the Heterosomata, which includes some of the most important and valuable food-fishes in various parts of the world. In India, however, we are ignorant of the economic importance of these members of the finny tribe, because our fishery resources are not at all developed and full advantage is not taken of the vast wealth of the sea. Moreover, the methods employed for fishing in this country are not suitable for the capture of the Flatfishes which live at the bottom and rarely swim about.

It is a matter of great satisfaction that the Natural History Section of the British Museum has once again supplied the great need by undertaking the publication of "A Systematic Monograph of the Flatfishes (Heterosomata)" the first volume of which has already made its appearance and deals with three out of five recognised families of the group—the Psettodidæ, Bothidæ and Pleuronectidæ. The remaining two families—the Soleidæ and Cynoglossidæ—it is promised, will be dealt with in another volume. Mr. J. R. Norman, Assistant Keeper in the Department of Zoology and the author of the work, is well known among ichthyologists for his brilliant researches on fishes. For some time he has been devoting considerable attention to the study of the Heterosomata of different parts of the world, no doubt as preparatory to the most admirable work he has now produced. What is especially noteworthy about this work is that the author has not ignored the needs of a general Zoologist, and though the work is primarily meant for specialists, advanced students will also find it a mine of information on all topics connected with the Flatfishes.

The volume under review is divided into two parts, the General and the Systematic. In the former such topics as Origin and Systematic Position of the Heterosomata, Fossil Heterosomata, Evolution of Asymmetry within the Order, Albinism, Ambicolouration and Reversal, Development, Sexual Differences, Classification and Geographical Distribution are dealt with. Abbreviations and a list of papers are given and notes are included on measurements and bibliographical method. In the Systematic Part 82 genera and 300 species are treated and it is remarkable that of 300 species only 24 have had to be included solely on the evidence of the published descriptions whereas all the other species were either studied by the author or examined by Colonel Tenison. There are 317 text-figures and practically every species is illustrated. The figures are simple and neat, and they show very clearly the salient features of the fish they are meant to portray. For the figures we are indebted to Lieut.-Colonel W. P. C. Tenison. The volume contains a useful and comprehensive index.

The work is admirably written and well got up; it will be of the greatest service to all desiring the latest information about the Flatfishes. We must congratulate the author on his performance and the Trustees of the British Museum for having published the Monograph.

S. L. HORA.

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TEXT-BOOK OF GENERAL ZOOLOGY. By Winterton, C. Curtis and Mary J. Guthrie with the collaboration of Katherine R. Jeffers. Second Edition. (John Wiley & Sons, New York, Inc. Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London. xv+554 pp. 1933.) Price 23*s*. nett.

The study of Zoology in the Schools and Colleges is undergoing a refreshing change and any departure from the study of types detached from one another, with no more interest than a detailed account of their anatomy, systematic position and developmental history can confer, must be welcome. This book expounds the principles of general Zoology from a new standpoint and is an extremely well-written book at that. The study of animals from a biological standpoint but not chiefly as representatives of phyla, is far more profitable as an educational course than the method usually adopted by the old books now in common use in the Indian Schools and Colleges. Even a comparative study of structural details, however valuable as a means of obtaining a comprehensive knowledge of the physical characters, is not free from defects. The value of any department of knowledge lies in its capacity to make the mind alert and inquisitive and after reading this book, we conclude that it possesses this quality in an eminent degree. In the American Schools, the Project Method is influencing the teaching of science and this idea coupled with the "Humanistic aspects" of the subject is the basis of the book. Most of the manuals and text-books of Zoology commence with the unknown, and this method must largely account for the sterile effect

produced by the teachers. The proper approach to Zoology is through a study of the vertebrate organisation and functions, with ecological references so that facts and phenomena familiar to the student may be used as the ground-work for building up advanced interests.

The first few chapters are devoted to a review of the natural history, the anatomy, physiology and the development of vertebrates, followed by a clear and adequate account of general scientific principles and classification. The systematic portion of the various phyla has taken up eight chapters; this part of the book is not calculated to impress upon the mind of the learner the enormous richness and variety of the material comprising the province of his study. The final chapter dealing with the history of organisms is a clear exposition of the theory of Organic Evolution. The book is beautifully illustrated. There is an excellent glossary.

There are a few mis-statements; the following is one among them: "With few exceptions, the amphibia are confined to water and its immediate vicinity, or to a moist atmosphere. It is this characteristic that has given to these vertebrates the name amphibian which means 'leading two lives'" (p. 13). In a popular sense this description is true: but if it is not corrected by the scientific significance of the term "Amphibia", the impression created would be totally wrong. An amphibian is an animal which at one time or other of its life history possesses a circulatory system adapted both for aquatic and terrestrial existence; and this idea ought to be brought home to the mind of the students from the commencement of zoological studies. Fig. 22 on page 34 needs considerable improvement. The liver of the frog is not connected with the heart; its relation together with the pancreas, to the intestine must be properly indicated; the reproductive organ which is obviously an ovary, as the oviduct is shown, is surely not connected with the kidney and its shape is exactly like that of testis. The glottis is shown as a structure discrete from the pharynx. On page 298, under Anthoxoa, occurs the following sentence:—"These corals are like small sea-anemones to which a skeleton of carbonate of lime has been added as a secretion from the ectoderm." The sentence ought to begin thus, "These coral polyps are like, etc." On page 407, is given the description of the "deep nervous system" of the star fish and its position, *viz.*, "beneath the ventral epidermis" is clearly wrong. Its relationship to the haemal system is not indicated.

These are, however, a few errors which must inevitably occur and they are easily corrected. They do not detract from the general merit of the book. It has a great educational power and value.

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THE PROGRESS OF MAN. By A. M. Hocart. (Methuen & Co., Ltd., London, pp. xvi+296, 1933). Price 7*s*. 6*d*. net.

This interesting book is a solid contribution to anthropological science and its purpose, *viz.*, a survey of the evolution of man and his works, in its bearings on physical anthropology, comparative psychology and cultural history of the human race, is admirably fulfilled. The domain of Anthropology is not only savages and curious peoples, but also civilised men; whatever is connected with human beings acquires a value and significance only when viewed from its evolutionary standpoint. It is true that the anthropologists are divided on the question of the treatment of their subject; and the voluminous data collected by patient and prolonged researches must possess little practical importance if treated as isolated studies of processes and phenomena: on the other hand they become intelligible when considered as part of the working of mind which though essentially simple, reacts diversely to the amazingly complex influences of the environment to which it is subjected. It is the power and richness of human mind and body in their manifold adaptive modifications, which offer the basis of all anthropological investigations; and their results acquire the validity of science in so far as they yield general principles capable of application to related groups of facts. The book deals with the facts of anthropological studies as one connected whole and its merit is that the seemingly diversified topics of human science are brought under a few basic formulæ.

In the chapter on Clothing, we read that "hairless man was evolved in a mild or warm climate where clothes are not needed for warmth", but could it be suggested that in Arctic climate, man still retains his primitive natural investment of hair? Rather we are disposed to think that whatever may be the influence of climatic

conditions, hairlessness of the body is probably the result of sexual selection. It is difficult to determine whether "clothes" were invented for purposes of protecting the body, or covering modesty or alluring by concealment, and perhaps more than one theory will have to be invoked for providing a satisfactory explanation. Modern picture films and suggestive bathing costumes lend support to the view that clothing produces shame.

On page 134, Buddhism is spoken of as a religion recognising Gods; rather its cardinal doctrine is "Nirvana" or "Nihilism"; right thinking and correct living are their own reward and are not the means of acquiring eternal bliss in Heaven. Nevertheless the chapters on "The Quest of Life", "The Sacraments" are extremely interesting.

On page 204, we read that "in India the idea of a soul is vague". We wonder if there is a single system of religious philosophy other than the "Upanishads", which offers a more complete, consistent and satisfactory theory of "soul", and these works have formed the basis on which the most magnificent systems of metaphysics have been reared and they still continue to inspire all philosophical thinkers. In a sense "soul" must remain an elusive subject and notions of it must be even vague, for unless a thing can be seen, handled and measured, its knowledge can be neither real, clear nor precise.

Again on page 282, discussing the relationship of Hamito-Semitic and Aryan languages, the author gives some curious translations of expressions selected from the inflected Dravidian and the agglutinative languages and the rendering is clearly wrong. For "the stick falls" Tamil says—"stick fall it"; for "in the house", "house place". The Tamils are ignorant of such expressions.

"The games of children merely reflect the culture of their elders" is a theory of play which will not be readily or universally accepted. There is hardly any game without two contending parties and the object of the engagement is victory or the assertion of the superior prowess of one over the other. The games of children may be rehearsals of the hunting instincts of their ancestors, *e.g.*, "Hide and seek" or an expression of the primitive longings of man to over-power the weaker members, which education, example and public opinion conjointly labour to humanise.

The last chapter about "Whither" is the shortest, but by far the most suggestive.

The blemishes that we have noticed are purely of a minor character, but do not detract from the general excellence of the book which every anthropologist will, we are confident, welcome as a successful attempt at synthesising the most salient facts which have been accumulating perhaps since 1881.

wavelengths greater than 290 $m\mu$, which may be attributed to the 300 $m\mu$ band absorption.

The absorption spectra of nitrates in the crystal state and in the fused state have also been studied, and the absorption curves are very similar to those obtained with aqueous solutions. Thus in these states also, the absorption bands have presumably the same origin and are due to the two types of photo-dissociation of NO_3^- described above.

It is remarkable that when the absorption measurements are made with *single crystals* of KNO_3 and $NaNO_3$, in which the NO_3^- ions are all orientated parallel to one another, the above two absorption bands are very intense when the incident light-vibrations lie in the plane of the NO_3^- ions, while for the vibrations along the normal to the NO_3^- planes the absorptions are much feebler.[7] This experimental result, when considered in relation to the origin of these absorption bands given above, as due to the photo-dissociation of NO_3^- ion to NO_2^- ion and O atom in the ground state and in the excited state respectively, suggests that *the efficiency of the photo-dissociation of the NO_3^- ion is much greater when the exciting light-vibrations are in the plane of the NO_3^- ion than when they are along the normal to its plane.* Experiments are in progress to test this conclusion by direct measurements.

A detailed report of the work will appear in the *Symposium on Molecular Spectra* to be published by the *Indian Academy of Sciences.*

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[7] See Krishnan and Das Gupta, *Nature*, **126**, p. 12 (1930) and *Indian Journ. Phys.*, **8**, p. 49 (1933).

The Metabolism of Carotene: the Possible Role of the Reticulo-Endothelial System.

THE susceptibility of vitamin A-deficient animals to certain infections of a non-specific type is now generally recognised, and though Harris[1] has indicated the probable course of events in the epithelial cells deprived of vitamin A, the root-cause of the defect in the defence mechanism of the tissues is still unknown. An impairment of the functioning capacity of the reticulo-endothelial system has been suggested as the primary effect of vitamin A deprivation, and the experimental studies of Lassen[2] lend a certain degree of support to this view, though it appears that even in advanced stages of vitamin A deficiency the anti-body producing mechanism may still be functioning with effect.[3]

Our observations made during studies on the metabolism of carotene, however, indicate a possible rôle of the reticulo-endothelial system in the animal function of the formation of vitamin A from carotene. On following the course of colloidal carotene injected into the blood stream, it was found to disappear rapidly from the circulation and appeared to be localised chiefly in the liver, the spleen, and to a smaller extent in the lungs, as evidenced by the amount of yellow colour of the ether extract of the tissues. In view of the capacity of these cells for phagocytosis and intracellular digestion it was probable that these cells which abound in the liver and the spleen take up the pigment though histological evidence on this point could not be obtained.*

When carotene was administered to a dog as a course of intravenous injections of the colloidal pigment for a certain period, no increase was noticed in the vitamin A content of the liver (a piece of the liver was removed by a surgical operation before the injections to act as control), while spleen (ordinarily deficient) appeared to contain large stores of vitamin A, almost approaching the liver in its richness.[4] The presence of a large proportion of the pigment in the spleen after its injection and later a large store of vitamin A is significant, as this organ while probably the richest store-house of the reticulo-endothelial cells has not been previously known to contain

[1] Harris, *Lancet*, **2**, 614, 1932; *Annual Rev. Biochem.*, **2**, 272, 1933.

[2] Lassen "Experimental Studies on the Course of Paratyphoid Infections in Avitaminous Rats, Copenhagen," 1931; *Z. Immunitäts*, **73**, 221, 1932.

[3] Zilva, *Biochem. J.*, **13**, 172, 1919; Werkman, *J. Inf. Dis.*, **32**, 247, 1923; Werkman, Baldwin and Nelson, *ibid.*, **35**, 549, 1924; Cramer and Kingsley, *B. J. Expt. Path.*, **5**, 300, 1924.

* Professor J. C. Drummond has obtained evidence that the Kupfer cells of the liver and similar cells of the spleen rapidly take up the pigment from the blood after its introduction into circulation (private communication).

[4] Ahmad, Grewal and Malik, *Ind. Med. Gaz.*, June Number, 1934 (*in the press*).

any appreciable amount of the body stores of vitamin A.[5]

A similar observation has been recorded in the case of a cat fed with carotene for a short period, though the concentration of vitamin A in the spleen did not approach the high figure recorded in the case of a dog and was much less than that of the liver. It may incidentally be pointed out that the previous observations of Ahmad[6], Rea and Drummond,[7] and Ahmad and Malik[8] on the inability of the cat to form vitamin A from carotene, may be due to the reason that higher animals like cats and dogs in which the spleen is more highly developed and contains in its meshes a large proportion of the reticulo-endothelial cells (as compared to the liver), vitamin A may appear first in the spleen which those authors omitted to examine. But the question must needs be further investigated.

In the short term experiments[4] in which the increase in the vitamin A content of the liver was taken as the criterion of the formation of vitamin A from carotene administered intravenously, it appeared that it was only in the rabbit that any significant amount of vitamin A formation took place, while it failed in other species of animals. That this should be so, may be due to the probability that the reticulo-endothelial system of the rabbit is functionally more powerful, which is supported by the common observation that of all the experimental animals the rabbit responds more quickly in immunisation experiments.

At the same time one might take into consideration the analogous rôle of the reticulo-endothelial cells in the phagocytosis and ingestion of red-blood cells and the formation of bilirubin.[9] Further analogy is furnished by the rôle of monocytes in anti-body formation from foreign proteins.[10]

[5] Sherman and Boynton, *J. Amer. Chem. Soc.*, **47**, 1646, 1925; Kerppola, *Skand. Arch. Physiol.*, **56**, 181, 1930; Moore, *Biochem. J.*, **25**, 275, 1931; Simmonet and Busson, *Comp. Rend. Soc. Biol.*, **109**, 182, 1932; Davies and Moore, *Biochem. J.*, **28**, 288, 1934.

[6] Ahmad, *Biochem. J.*, **25**, 1195, 1931.

[7] Rea and Drummond, *Z. Vitaminforsch.*, **1**, 177, 1932.

[8] Ahmad and Malik, *Ind. J. Med. Res.*, **20**, 1033, 1933.

[9] McNee, *Quart. J. Med.*, **26**, 390, 1923.

[10] Hekteon and Carlson, *J. Inf. Dis.*, **7**, 319, 1910; Luckhardt and Becht, *Amer. J. Physiol.*, **28**, 257 & 274, 1911; Topley, *J. Path. Bact.*, **33**, 339, 1930.

There is a striking parallelism between the concentration of reticulo-endothelial cells and the concentration of vitamin A in tissues of the animal body. Liver is a rich store of both. Spleen which might have been an exception is now known to contain relatively large amounts of vitamin A in higher animals particularly after a high carotene intake. Other animal tissues containing appreciable quantities of vitamin A are the adrenals, blood, lungs, bonemarrow, and the kidneys, all of which abound in the reticulo-endothelial cells with the exception of the last named. Of course, it should be taken into consideration that different types of reticulo-endothelial cells may have differentiated functions.

An attempt has been made to study this question further by examining the effects of splenectomy and the blockade of the reticulo-endothelial system in the rat during carotene administration. The results are on the whole inconclusive. The method is fraught with the obvious danger that the blockade or the removal of the reticulo-endothelial cells at one centre would lead to the active proliferation of these cells in other tissues.

This fragmentary evidence presented here is strongly suggestive. It is reported in the hope of stimulating investigations into this question at other centres of research.

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May 30, 1934.

Notes on the Occurrence of *Grammothele cineracea* Bres. *Kneiffia grisea* Berk. and Curtis.

Grammothele cineracea Bresadola, a member of the family Hydnaceæ, is very common in Bengal; but curiously enough no report as to its occurrence in India has yet been made.[1] This unique and conspicuous species is not rare to a careful observer. It grows on trunks of *Phœnix sylvestris* and other palms, particularly on the persistent leaf-bases near the soil. I have also seen it growing on logs and posts. The fructification is entirely resupinate and crustaceous, characterised by

[1] Butler and Bisby, *The Fungi of India*, 1931.

the hymenium which is distinctly polyporoid. It is closely adpressed to the substratum and extends up to a foot in length. When fresh, the fungus is of dark ash-grey colour with a shining lustre which no one can afford to overlook.

Prof. Burt to whom the specimen was sent has also identified it as *Grammothele cineracea* Bres. He further writes to me to say that this species was first described from specimens collected in Cuba, under the name of *Kneiffia grisea* Berk. and Curtis.[2] Its inclusion in *Kneiffia* was, however, unfortunate. It was next collected by Rev. Rick at Sao Leopoldo, Rio Grande du Sol, Brazil, South America. These specimens were distributed in the exsiccati of Theissen Decades *fungorum brasiliensium*, No. 5. The same species was again reported from the Philippines and described by Bresadola as *Grammothele cineracea*.[3]

The name *Grammothele grisea* Berk. and Curtis should have been the proper nomenclature for this species. But as it is already pre-occupied by another species of the same authors, the type specimen of which was also collected at Cuba and a description published along with that of *Kneiffia grisea* Berk. and Curtis,[2] the comparatively recent nomenclature adopted by Bresadola has been retained for this species. It is very near to *Poria hydnopora* Berk. which, according to some, is a species of *Grammothele* but differs from it in having smaller sub-angular pores and other characteristics.

SACHINDRANATH BANERJEE.

Department of Botany,
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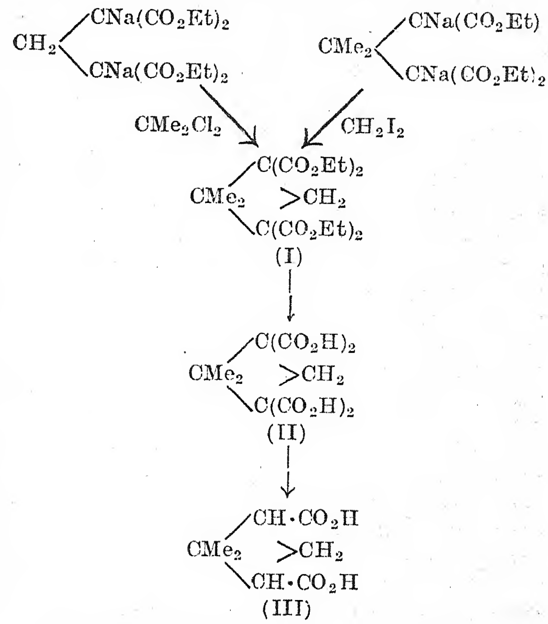
Calcutta,
May 30, 1934.

Two New Methods of Synthesis of Norpinic Acid.

THE synthesis of norpinic acid has been achieved by the following two new methods, namely, (1) by the condensation of sodium methylene dimalonic ester and $\beta\beta$-dichloropropane, and (2) sodium derivative of isopropylidene dimalonic ester with methylene iodide.



The tetracarboxylic ester (I) suffered hydrolysis and decarboxylation simultaneously on being boiled with 50 per cent. sulphuric acid yielding *trans*norpinic acid (III) m.p. 145-146° softening at 136°. The tetracarboxylic acid m.p. 200° (II) obtained from (I) by hydrolysis with alcoholic potash was decarboxylated by heating at 220-240° or by boiling with 50 per cent. sulphuric acid. The yields of II and III are poor.

As a result of a large number of experiments conducted under varying conditions, it has been possible to effect considerable improvement upon the methods of preparation of isopropylidene malonic (yield 1315 g. from 1170 g. of malonic ester) and dimalonic (yield 42 g. from 80 of isopropylidene malonic ester) esters described by Clemo and Welch (*J. C. S.*, 1928, 2621).

P. C. GUHA.
K. N. GAIND.

Department of Organic Chemistry,
Indian Institute of Science,
Bangalore,
May 31, 1934.

Conversion of *Meso*tartaric Acid into an optically active form by Walden inversion under asymmetric conditions.

ORGANIC compounds, containing asymmetric centres in their molecule, but inactive due to internal compensation, are generally supposed to be non-convertible into the active

[2] *Journ. Linn. Soc.*, **X**, p. 327, 1868.

[3] *Hedwigia*, **56**, p. 299, 1915.

enantiomerides and there is no mention in chemical literature of any attempt having been made so far to achieve such a conversion. It appeared probable that if by any means the disposition of the atoms or groups attached to one of the asymmetric carbon atoms in an internally compensated compound can be altered, the resulting compound might show optical activity. But any such alteration, tried under normal conditions, by which the internal compensation can be disturbed provides a scope for the production of both the *d*- and *l*-forms in equimolecular proportions giving rise to a racemic product. Just in accordance with this concept, it was found that ethyl *meso*tartrate by the action of phosphorus pentachloride (Anna Rao and Guha, *Ber.*, 1934, **67**, 741) gave diethyl *dl*-β-chloromalate.

To overcome this difficulty, it was planned to study Walden inversion process on *meso*-tartaric acid under asymmetric conditions. If, in place of the ethyl ester, optically active ester groupings are introduced, it is hoped that, under the influence of the active ester groupings there would be formed an excess of one of the two antipodes from which an active product would arise after the ester groups have been knocked out.

An experimental verification of this conception has now been made. *l*-Menthyl *meso*tartrate has been taken as the starting material. The halogenation has been conducted by means of phosphorus pentachloride and hydroxylation by means of silver oxide or alcoholic potash. It has been found that during hydroxylation, the ester groups are also split up and the end product yields a small amount of *l*-tartaric acid according to the scheme:

$CO_2C_{10}H_{19}$		$CO_2C_{10}H_{19}$		CO_2H
HO.C.H.	PCl_5 →	HO.C.H	Ag_2O → or KOH	HO.C.H.
HO.C.H.		H.C.Cl.		H.C.OH.
$CO_2C_{10}H_{19}$		$CO_2C_{10}H_{19}$		CO_2H
l- menthyl *meso*-tartrate		*l*- menthyl-*l* β-chloromalate I		*l*-tartaric acid

The identity of the compound (I) has been confirmed by reducing it in an alcoholic solution by means of aluminium-mercury couple, and hydrolysing the reduction product by potash whereby an acid showing *laevo*-rotation is obtained. There is no theoretical possibility of any optically active acid other than malic acid being formed in this process.

P. C. GUHA.
V. ANNA RAO.
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June 9, 1934.

X-Ray Analysis of the Crystal Structure of Dibenzyl.

DIBENZYL crystallises in the monoclinic prismatic class. A preliminary X-ray analysis by Hengstenberg and Mark[1] shows that it belongs to the space group C_{2h}^5 with two molecules in the unit cell; the molecules possess a centre of symmetry. I have made a detailed X-ray analysis of the structure of this crystal, and the positions of the various carbon atoms in the unit cell are as follows: The 6 carbon atoms of each benzene ring form a regular hexagon as in diphenyl[2]; one of the aliphatic carbon atoms, *viz.*, C, (see Fig. 1) lies on the prolongation of the line joining the atoms 4 and 1, and the other

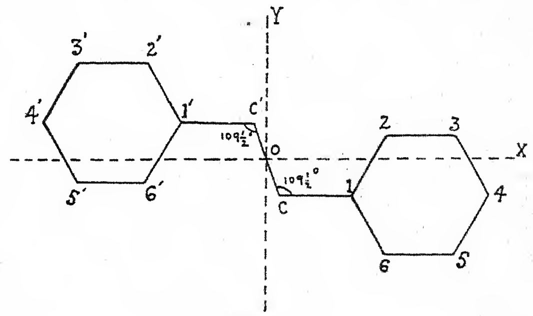

Fig. 1.

on the line joining 4′ and 1′ (adopting the usual notation). The line joining C and C′ makes with each of the above lines (*viz.*, 4 1 and 4′ 1′), the usual tetrahedral angle of 109½°. Further, the two benzene rings do not lie in the same plane, but lie in parallel planes slightly separated from each other. Thus in Fig. 1, all the carbon atoms on the right hand side of OY may be supposed to be raised above the plane of the paper by about 0·12Å, and all the atoms on the left side to be pushed below the plane by the same distance.

In order to define the orientations of the molecules in the unit cell, consider in Fig. 1

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1 *Z. f. Krist.*, **70**, 283, 1929.
2 *Ind. J. Phys.*, **7**, 43, 1932.

the two perpendicular axes OX and OY lying in the plane of the paper and fixed to the molecule. It is found that the OX axes of both the molecules in the unit cell lie in the b (010) plane in the obtuse angle β, making an angle of 32° with the 'a' axis (and 84° with the 'c' axis). The OY axes of the two molecules are inclined at *plus* and *minus* 60° respectively to the b (010) plane.

The orientations suggested here are identical with those deduced by Krishnan and Banerjee[3] from their magnetic measurements on this crystal. Their values for the above angles are 32° and ± 60° respectively.

The details of the analysis will be published shortly in the *Indian Journal of Physics*.

JAGATTARAN DHAR.

210, Bowbazar Street,
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June 12, 1934.

[3] *Nature*, **130**, 313, 1932.

The Kasauli Antivenene.

By S. D. S. Greval, Major, I.M.S.,
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AFTER Calmette had prepared a polyvalent antivenene at the Pasteur Institute, Lille, the preparation of a similar antiserum was commenced at the Pasteur Institute, Kasauli, in 1901. By 1902 "1,020 bottles each containing 15 c.c. were distributed all over India". It was soon realised that excepting the venom of the cobra (*Naia*) the different snake venoms produced antivenenes which were strictly specific: Hence the necessity of preparing an antivenene against the Russell's viper in India. In 1905 the Central Research Institute, Kasauli, took over the preparation of the antivenene from the Pasteur Institute and started issuing to the public a combined antivenene against the cobra (*Naia*) and the Viper (*Vipera russelli*). During the following 29 years the details of preparation and standardization of the serum underwent very little change. The large bulk of antivenene which it is necessary to use has always been a disadvantage and various attempts had been made in the past to get over this difficulty by concentrating the serum. This has now been accomplished and during the present year a concentrated antivenene has, for the first time, been issued for general use. The protecting substance of the crude serum has been concentrated four times and the inert blood proteins have been eliminated. The dose of 10 c.c. issued now represents the 40 c.c. dose of the crude serum issued formerly and makes it possible to administer safely the maximum amount of serum needed for a bite of maximum intensity.

The concentration has been brought about by the application of the standard method of concentration of antisera by ammonium sulphate. The protecting substance is removed from the plasma by a fractional precipitation with the salt. To the oxalated plasma are added 3% of a 4% solution of calcium chloride, two volumes of tap water and about 18% of the total volume so obtained ammonium sulphate, adjusting the specific gravity to 1099. The resulting precipitate (fibrin and euglobulin) is filtered off. To the filtrate is added about 10% more of ammonium sulphate and the specific gravity adjusted to 1133. The resulting precipitate is the pseudoglobulin and with it is associated the protecting substance in the blood of the horses immunised against snake venom. This precipitate is collected, pressed and dialysed. To the dialysate are added 1% of sodium chloride, enough sodium carbonate to give a reading of pH 7·6 and an antiseptic. It is then allowed to stand undisturbed until clear and filtered through a Seitz filter. The finished product is a clear fluid with a greenish or at times brownish tinge. Its protein content is below 16% and the viscosity is about six times that of normal saline.

The details of the procedure will be published shortly in the *Indian Journal of Medical Research*.

The serum is made only against the cobra and Russell's viper. It has no effect against the bite of the "Krait" (*Bungarus*) or "phoorsa" (*Echis*). As a great majority of the deaths from snake bites in India, however, occur from the bites of the first two snakes, making the antivenene polyvalent at this stage would interfere seriously with its ultimate potency against these snakes. It is hoped that in the near future it will be possible to adopt better means of immunisation, obtain more potent sera and mix them to make a polyvalent serum.

Obituary.

Dr. A. N. Meldrum, I.E.S.

ANDREW NORMAND MELDRUM died in Edinburgh on the 14th of March 1934, as the result of an accident. He was born on March 19th, 1876, and was educated at the Royal College of Science, London, Aberdeen University and the Victoria University, Manchester. He obtained the A.R.C.Sc. (London) in 1896 and the D.Sc. of Aberdeen in 1904. Before he came to India he was a member of the chemical staff at the University College, Liverpool, and of Aberdeen University.

Dr. Meldrum joined the Indian Education Service in 1912, and was appointed to the Professorship of Chemistry at the M. R. Science Institute of the Gujrat College, Ahmedabad. In 1922 he was transferred to the Royal Institute of Science, Bombay, as Professor of Chemistry, and he was appointed Principal of the Royal Institute of Science, in 1925. He retired on reaching the age limit in 1931.

When Dr. Meldrum came to the Bombay Presidency he first devoted himself to organising the Laboratories of the M. R. Science Institute, and to improving the Science courses of Bombay University. These courses and the methods of teaching science employed throughout the Presidency owe much to him. When the foundation was laid, he turned his attention to training students in the methods of research. Many of those who are now doing research and teaching work in the Presidency were his students. He worked chiefly on the chemistry of chloral compounds, and as his knowledge of chemistry was wide, he also carried out investigations for the Department of Industries on problems of industrial interest, and studied the electrical properties of acids, such as boric acid in solution. Between 1926 and 1931, 22 students obtained the M.Sc. degree by thesis under his guidance.

He did not limit his activities to Bombay, for he served as President of the Chemistry Section of the Indian Science Congress, and he was for a time Editor of the *Journal of the Indian Chemical Society*.

During the years he was in Bombay he took an active part in University affairs, and was a member of the Senate and the Syndicate, and served on a great number of University Committees. In 1930, he was elected Dean of the Faculty of Science. He took a prominent part on the Committee which did the preliminary work, leading to the founding of the new Bombay University Department of Chemical Technology. Dr. Meldrum was nominated by Government as a Trustee of the Prince of Wales Museum of Western India, and as a member of the Provincial Council for Agricultural Research.

Dr. Meldrum left India in 1931 amidst the hearty good wishes of his many friends for a happy retirement, in which he would enjoy a well-earned rest. A Committee was appointed to establish a memorial in his honour, and an annual prize known as the Meldrum Memorial Prize has been founded in the Royal Institute of Science. He settled down in Edinburgh, and devoted himself to these studies in the history of chemistry in which he had always been interested. He was one of the lecturers at the Priestly Celebration of the Chemical Society in 1933. He was peculiarly fitted for studies in historical chemistry, for added to a wide knowledge of science and a scholarly outlook, he possessed, unlike many scientists, a graceful English style.

He was not, however, to enjoy his retirement long. His only son died in 1933. He then decided to move to Berkshire, to be near his daughter, studying at Oxford, and he died while in Edinburgh completing the final preparations for moving. He leaves a widow and two daughters.

In Bombay educational circles he will long be missed. The Royal Institute of Science is much the poorer for his going, but the spirit which he inculcated will always remain. He has left a memory of a brilliant and painstaking teacher, who had a special pride in seeing that the foundations of the subject in the student's mind were well and truly laid, of a pleasant colleague, and of a just but sympathetic administrator. In his capacity as Principal he so bore himself, that all respected him, that most liked him, and that there were none who could deny to him the attributes of firmness, efficiency, and impartiality. Time will not dim his memory in the minds of those who had the pleasure of knowing him and the privilege of working with him.

T. S. W.

A Simple Air-conditioning Chamber for Laboratory Experiments.

By S. N. Kapur and D. Narayanamurti,
Seasoning Section, Forest Research Institute, Dehra Dun.

FOR the carrying out of various investigations on the physical and physico-chemical properties of wood, which are now in progress in this laboratory, it was considered necessary that such experiments should be conducted under controlled conditions of temperature and humidity. The importance of having constant temperature and humidity conditions during the course of an experiment has been recognised in recent years not only in timber physics but also in other branches of research, such as the study of textile fibres, paper pulp, drying of paints, corrosion of metals, etc. Several authors have described methods of controlling temperature in large air thermostats (*vide* Clark, *Hydrogen Ions*, 1925, p. 232; U. R. Evans, *J. Soc. Chem. Ind.*, 1931, **40**, p. 66; and W. H. J. Vernon, *Trans. Farad. Soc.*, 1931, **27**, pp. 241). For controlling the relative humidity of air in a chamber various arrangements have been described,

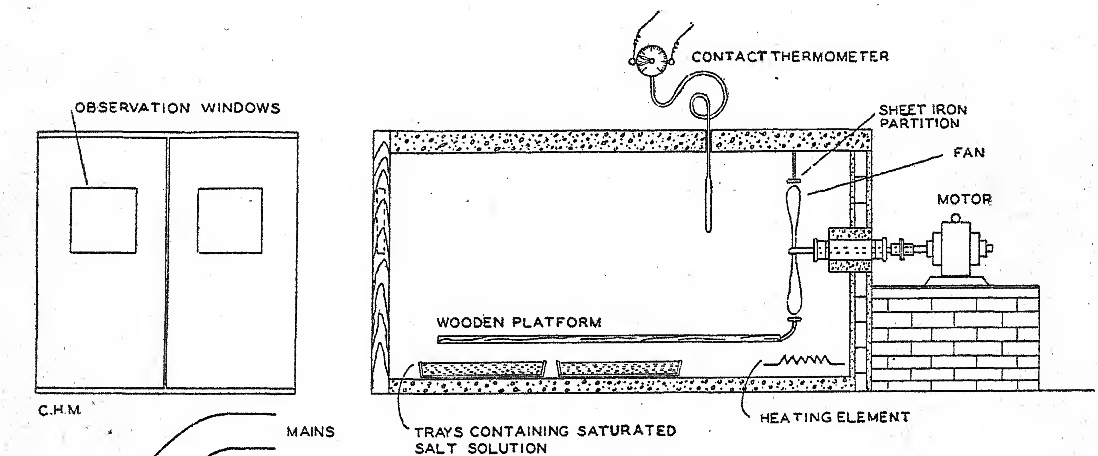

FIG. 1.

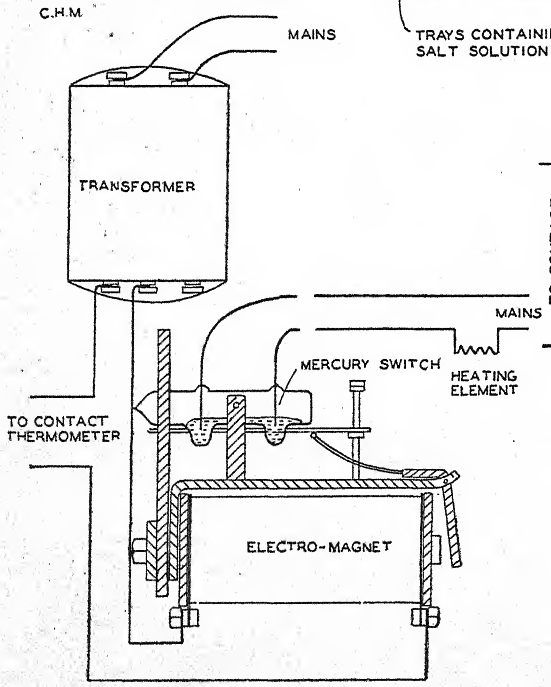

FIG. 2.

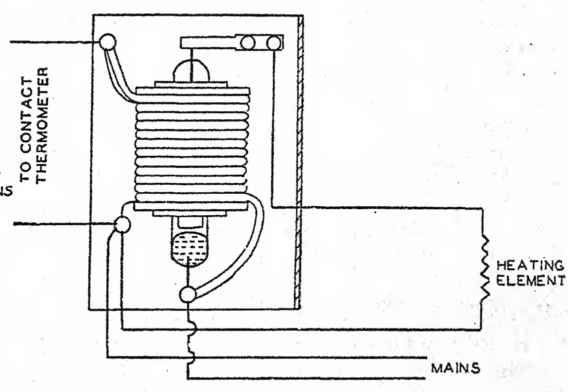

FIG. 3.

that of Vernon and Whitby (*Trans. Farad. Soc.*, 1931, 27, p. 248) being quite accurate. The method, however, could not be adopted for large-scale experiments on the shrinkage and swelling of wood, where a rapid and uniform circulation of air is desired.

After several preliminary experiments, it was found that the most suitable arrangement was to circulate air by means of a propeller fan inside a closed chamber, control the relative humidity of air by means of saturated salt solutions, and maintain the desired temperature by means of heating elements operated by contact thermometers and mercury switch relays. Fig. 1 shows the constructional details of the cabinet.

The chamber is constructed of brickwork and concrete, as wood was found to warp badly with alterations in humidity from one extreme to the other. It is about 5 ft. long, 3 ft. wide and 3 ft. high. The inner walls of the chamber are plastered with a special water-proof cement and are further painted with a moisture-proof composition to reduce the absorptive capacity of the brickwork. The front is provided with two hinged wooden doors, each having a small glass window, through which the specimens inside can be reached without opening the door, thus avoiding any considerable disturbance of conditions inside the chamber. For air circulation, the blades of a fan are mounted on a shaft running in ball bearings as shown in the sketch and the fan is driven by an electric motor. The fan is placed in the centre of a sheet iron partition at the back of the chamber. A wooden platform divides the chamber into two parts, the lower one having trays containing saturated salt solution for maintaining the desired humidity. At the back of the trays one or more electric heating elements are fitted to supply the heat necessary for maintaining the required temperature.

For temperature control, a distance reading mercury-in-steel thermometer with adjustable electric contacts of the type manufactured by Messrs. Negretti and Zambra, London, is used. Mercury-in-glass contact thermometers manufactured by Messrs. Hermann Juchheim of Ilmenau, Germany, have also been found satisfactory. The latter have the advantage that sparking does not spoil the mercury contacts on account of the presence of an inert gas sealed in the capillary tube. The electrical arrangements adopted are shown in Figs. 2 and 3. Two kinds of circuits have been used, one operating with an Isenthal 'mercury switch type' relay and the other with a 'Vertex' regulator manufactured by Juchheim. The latter type differs from the former and other usual types in its manner of operation, in that the heating circuit is switched on when the magnet coil is excited. It essentially consists of a magnet system and a plunger type mercury switch. The system is connected directly to the mains, when the magnet is excited, which pulls the plunger down, thus switching on the heating circuit. When the proper temperature is attained, the current is closed through the contact thermometer shunting the magnet coil with the result that the heating circuit is switched off.

For control of humidity, as mentioned above, saturated salt solutions are used, which are kept in trays on the floor of the chamber.

The salts which we have used in our work and the relative humidities obtained are given below. For other humidities, a suitable selection can be made from the data given in the *International Critical Tables* (*vide* 1, p. 67).

Chemicals		Relative humidity at 35° C.
Water only	..	95%
NH_4Cl and KNO_3	..	70%
$Na_2Cr_2O_7.2H_2O$	..	52%
$K_2CO_3.2H_2O$	..	42%
$KC_2H_3O_2$	..	28%

Chambers as described above have been running in this laboratory for over two years. With reasonable care the largest variation in temperature is not more than 0·1°C. and the humidity variations seldom exceed 3%. Higher sensitivity with regard to temperature control can of course be attained by using a toluene regulator of sufficient capacity and by more efficient lagging of the chamber.

The Leaf, Flower and Fruit Characters of the Santra Orange.

By S. S. Bhat, M.Ag.,

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DURING the course of several years of work on the Die-back disease of citrus trees in the Bombay Presidency, the writer had opportunities to study the Santra* orange tree in detail. The following observations may be of some interest:—

The leaves of Santra are unifoliate, glabrous, elliptic and accuminate, with a lighter colour on the lower surface than on the upper one. They are leathery in texture and have entire or very slightly serrated margin. Their average length is 6-7 cms. and the average maximum breadth 3-4 cms. The average leaf factor is 2. They contain a large number of small round oil glands. If crushed, they give out a mild and somewhat agreeable characteristic aroma. The petioles are naked, and the wings are very narrow if present. The leaves are alternate or spiral with three to five leaves in a spire.

Internally the leaves are seen to contain a large number of cystolyths of Calcium oxalate. They are larger in size and more in number in the leaves of trees grown in limy soils. Examining sections of leaves of Santra plants grown in the *shadu* soil which contains over 15% of lime, as well as of those grown in compost containing only 0·3% of lime ($CaCO_3$), it was noticed that the cystolyths were larger and eleven in number in the former, and smaller and only nine in number in the latter, in a uniform length of 800μ. On the basis of this indication, both the leaves were analysed and it was found that, on dry matter, leaves from compost contained 7·15% of Calcium oxalate, whereas those from *shadu* soil contained 8·11 per cent. These figures, substantiated by other analytical figures, are interpreted to lead to the conclusion that (1) the orange trees are partial to calcium salts as they gather a large percentage of them (7·15%) even from a proportionately calcium-poor (0·3%) soil, and (2) there is a limit to such absorption as not more than 8·11% is taken in from a highly Calcium-rich (15%) soil.

The flowers of Santra are small, white and very sweet scented. They may be solitary in the axils of well-developed leaves or in small racemes. They are bisexual. Sepels are 5, petals are also 5 and free. Very rarely only four petals are found when one of them is bigger than the others and has a small at its apex. Thus it indicates a double petal. The stamens are sixteen to twenty, the filaments are long or short, variously connate, and compressed at the base. Usually two sets of connate filaments are found—one large with ten to sixteen filaments, and the other small with two to eight filaments. The anthers open after the flower opens. The style is short, medium, or long. When it is short, the stigma is almost close to the ovary, the flower is also smaller than usual, and it drops without setting fruit. When it is medium it is a little more than half the length of the stamens, and in such cases, the fruit may or may not set. The completely developed flower has a long style and the stigma is always in level with the anthers. The stigma comes into receptive condition some time before the flower opens and the anthers are ripe. The ovary is many-celled. The flowers generally open in the evenings and take several hours before they are wide open. The outermost petal opens before the others. To start with a small slit is seen at the apex of a fully developed flower bud; then it takes at least an hour before the free petal opens; then the others follow. Cool breezes hasten the opening of the flowers. The petals and the stamens drop soon after the pollination, but the style persists for some days until the ovary becomes deep green and well established.

The fruit of Santra is deep orange coloured when properly ripe. The rind is smooth and thin. It shrivels and presents prominent folds, when the fruit is kept for some days after harvesting. The cavity is generally absent. When present, it is narrow and small. There may be sometimes a small necklike projection of wavy rind near the stalk. The stalk is medium in thickness. The basin is shallow, broad and round. The size of the fruit is medium, the main axis measuring 7-8 cms., and the maximum diameter, 8-9 cms. The form of the fruit is round and oblate. The rind is full of small pits, with thickly placed oil glands. In ripe fruits, the rind is very thin, being only 2·3 mms. in thickness. When the fruit is ripe, the segments become loose and detached from the rind, with a white woolly material loosely occupying the interspace. In all stages of the development of the fruit, the rind is easily separable from the segments, except during the first two or three months. The number of segments in the fruit varies from 8 to 13. The segments are enclosed in a membraneous cover, which can be easily removed. They form the septa in the fruit which separates the different segments from one another. The core is open with a fairly big hollow, when the fruit is ripe, with the wool thinly placed in fine fibres which are attached crosswise to the walls. The pulp is bright orange in colour. It is very juicy. The juice is delicious, being sweet and well blended with sourness. The small juice sacks are spindle or needle shaped, with their base attached to the septa by thin delicate stalks. The juice sacs melt easily in the mouth and leave practically no rag. The seeds are about twenty per fruit and are irregularly distributed in the different segments. They are also medium in size, and mostly egg-shaped.

The Santra fruit takes about ten months for complete development from the time of flowering. The development of the fruit at various stages shows that in the first few months, the fruit is hard, with its rind closely adhering to the segments inside. The pulp is very acid and becomes more and more juicy after the fourth month. The skin becomes gradually loose from this period. The colour of the fruit begins to change from deep green to yellow and then to orange from the eighth month.

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*Santra is *Citrus nobilis*, variety *deliciosa* (Cheema, G. S. and Bhat, S. S., "A study of the citrus varieties of the Bombay Presidency," *Current Science*, February 1934.

Some Physical and Chemical Considerations on Plant Nutrition and Growth.*

By B. Viswa Nath.

IN spite of the large amount of work that is being done all over the world, the subject of plant nutrition continues to be a puzzle. To those who have grown plants in solution, solution *cum* sand, pots and under field conditions and compared the results, the discrepancies and anomalies must be evident. The writer's experience with such crop plants as rice, millets, cotton and sugarcane has set him to think on some chemical and physical aspects of plant metabolism and growth and to enquire how far plant growth can be regarded as a chemical reaction. Pending detailed publication, the salient points of the problem are now briefly mentioned.

Plant growth taken as a whole, is an integration of the plant's response to internal and external factors. Several of these are beyond control and even those that are amenable to control could be done so only imperfectly. Such internal processes as hydrolytic and dehydration changes and the synthetic processes concerned with carbohydrates, fats, proteins and other compounds, have been investigated and found to conform to known physico-chemical laws applicable to chemical reactions which the Chemist studies in the laboratory. When, however, plant growth and metabolism are examined as physico-chemical reactions in the light of modern knowledge some interesting points for discussion present themselves.

Viewed as a chemical reaction, plant growth is one of auto-catalysis. Starting with the germination of seed and its respirative activity, and following the increase in the weight of the plant, it is possible, from well-conducted experiments, to construct sigmoid curves when the results of periodical increases in weights are plotted against time intervals. Analysing the curve, three distinct stages may be differentiated, although it may not be possible to draw exact lines of demarcation. The first is the development period in which the inflow of nutrients occurs; the second is the assimilation period and the third is the period of redistribution of nutrients between the soil and the plant. The growth in the development period, and under conditions of increasing or decreasing magnitude of nutrient factor admits of interpretation in terms of the fundamental law of chemical reaction—the law of mass action—and its important principles, namely, the nature of reaction, the amount of reacting substances, the influence of catalyst on the reaction and, within limits, the temperature at which the reaction proceeds. This holds good generally for plant-growth as a whole in different kinds of substrates.

The understanding of the absorption of nutrients, however, presents difficulties. The absorption of nutrients by plants in soil involves the inter-relationship between soil and plant. It is generally believed that plants absorb nutrients only from solution and that the absorption is primarily concerned with ions. Considerable work was done on ion absorption and on selectivity and antagonism of ions. Several hypotheses were put forward to explain the conflicting results obtained. Recent comparative studies on soil and solution, direct pointed attention to the inadequacy of the existing hypotheses and to the necessity for discussion of several questions on the absorption of nutrients by plants and the mechanism involved in the process.

The selectivity and the differential nature of ion absorption, and the exchange of one ion for another in solution have led to the concept of permeability and as a consequence all theories in regard to permeability assume the existence of a permeable membrane. The nature of the substance that forms the membrane and the question whether permeability can be regarded as a purely physical phenomenon are still under discussion and the available evidence, in so far as plant nutrition is concerned, points to the direction that living membranes should be endowed with "physiological" as well as physical permeability, seeing that permeability alters with the death of the living cell and that such substances like organic and inorganic salts, acids, bases and water can enter into the plant.

Under field conditions with low moisture levels—sometimes even as low as 5 to 10 per cent on the weight of the soil and yet plants keep fresh and green and grow—the position is not similar to that in solution cultures. Under such circumstances it is difficult to explain the intake of nutrients by plants in terms of permeability and ionic hypotheses. As Osterhout points out, distinction appears necessary between permeability and absorption. The reactions occurring inside a plant cell or in the intracellular spaces, may remove ions from the sphere of action and thus enable considerable absorption of nutrients to take place without reference to the magnitude of permeability.

The selective absorption of ions is often sought to be explained by Donnan membrane equilibrium theory. Apart from the difficulties in checking the validity of such an explanation, it is doubtful if the theory can be applied to complex plant systems. That it is so is evident from the work of Briggs and Petrie who consider that in the plant the simple Donnan equation which is applicable to free ions would not hold in plant systems containing ions as undissociated salts of proteins or in a state of physical adsorption. A point deserving notice is that the ionic and permeability hypothesis does not adequately explain the absorption of silica in such large amounts by paddy and sugarcane plants. So also with organic manures applied to the soil. The gaps are too many and too big.

At this stage, one is reminded of the view advanced by Comber a few years ago, that plants can directly absorb the colloids in the soil. He postulates a direct union of the root hairs with soil particles. The root hair and the hydrophilous gel coating around the soil particle intermingle and form one system and enable the direct absorption of colloids. To those who are acquainted with exchange phenomenon in soils the concept of direct ionic exchange in plants with or without the intervention of permeability and membrane theories is but a simple step. Our work at Coimbatore and the experiments of Hans Jenny in America are suggestive in this direction.

* Text of a paper read before the Bangalore Easter Science Congress, 1934.

Evidence is accumulating in several laboratories in India and abroad to show that the physico-chemical laws applicable to plants, growing in solution cultures are not applicable to plants growing in soil and the time may soon come when we may have to apply ourselves to a radical reconsideration of our views on the mechanism concerned with the absorption of nutrients by plants under natural conditions.

Research Notes.

A New Isotope of Hydrogen of Mass 3.

A NEW hydrogen isotope of mass 3·0151 formed by the action of diplons on diplons is reported by M. L. E. Oliphant, P. Harteck, and Lord Rutherford (*Proc. Roy. Soc.*, A, **144**, 692, 1934). They have studied the effects produced when diplons are employed for bombarding targets covered with a thin layer of preparations containing heavy hydrogen. These were ammonium chloride, ammonium sulphate, and orthophosphoric acid, in which the normal hydrogen had been largely replaced by diplogen. In each case enormous numbers of fast singly charged particles were found to be emitted, consisting essentially of two prominent groups of ranges 14·3 and 1·6 cms. respectively. These groups containing equal numbers of particles have been identified, the first as protons, and the second as the nuclei of a new isotope of hydrogen of mass 3·0151. The reaction assumed is

$$_1D^2 + _1D^2 \rightarrow _2He^4 \rightarrow _1H^1 + _1H^3,$$

the mechanism being that as a result of close collision two diplons unite to form a new highly unstable helium nucleus of mass 4·0272, possessing an energy of about 23 million volts in excess over that of the normal helium nucleus of mass 4·0022, and this unstable nucleus then breaks up in a number of ways, one of which is indicated by the above equation. A second mode of disintegration into an isotope of helium of mass three and a neutron according to the equation

$$_1D^2 + _1D^2 \rightarrow _2He^4 \rightarrow _1He^3 + \text{neutron},$$

seems also possible, from among other considerations, the fact that a large number of neutrons are produced in the above experiment. This new isotope of helium of mass 3·0178 has, however, already been indicated in the bombardment experiments on lithium atoms of mass 6, by protons.

M. A. G.

Technique of Sputtering Sensitive Thermocouples.

IN a paper in the April number of the *Review of Scientific Instruments* Louis Harris and Ellis A. Johnson describe a method of construction of thermocouples sensitive to the alternating temperatures of sound waves or to small intensities of intermittent radiation. For both these purposes the thickness of the thermo-elements must be of the order of 10^{-5}cm. Cathodic sputtering offers a very convenient way of obtaining such films. The metal films are sputtered on to thin films of cellulose acetate or cellulose nitrate supported by a mica framework, in an atmosphere of argon. Using proper templates of mica during sputtering alternate strips of bismuth and antimony or bismuth and tellurium are obtained. The ends of the thermo-elements thus obtained are heavily sputtered with gold to which the leads, consisting of fine wires, are soldered. The hot junctions of the thermo-elements are blackened by evaporation of antimony under an air pressure of 0·5 mm. Used in conjunction with a low frequency amplifier even single junction couples of this type should be sensitive to about 2×10^{-10} calories per sq. cm. per sec., while multijunction elements permit the measurement of even lower radiation densities.

S. R.

Ultra-Violet Monochromators.

IN an article in the *Review of Scientific Instruments* (1934, 3, 149), C. R. Harrison has described some designs for a cheap but effective monochromator for the ultra-violet. The simplest of them consists merely of a spherical concave mirror immersed in a basin of distilled water at an angle of about 30° from the horizontal; this acts as a crude prism somewhat on the principle of the Fery quartz prism, and gives monochromatic though distorted images of a high power horizontal mercury arc used as a source. Its resolving power is less than that considered suitable for a commercial monochromator, but far greater than that expected of a filter. Such an instrument should be useful for many types of biophysical and photo-chemical work.

Further improvements could be made on the above design, such as for reducing the

distortion. It has also been suggested that it should be possible to make large prisms and lenses of ice kept cool at all times by mechanical refrigeration. A few preliminary experiments on figuring ice lenses have already indicated the possibility of making extremely large optical parts at low cost.

Brownian Movement of Rotation.

THE significance of the irregular Brownian movement of translation executed by tiny solid particles has been pointed out long ago in 1905 by Einstein and Smoluchowski as thermal vibrations in the sense of the gas kinetic theory. Now, these particles should also similarly exhibit irregular motions of rotation about their centres of gravity. V. Schmieschek has described an experiment (*Z. Techn. Physik.*, 1934, **15**, 178) which claims to photograph these motions and thus provide further experimental evidence for the gas kinetic theory. The principle of the experiment consists in allowing a very bright small spot of light as from the positive crater of an arc lamp to be reflected from the surface of a tiny silver crystal on to a photographic film. Regular hexagonal crystals of maximum diameter 0·03 mm. were prepared and suspended in water contained in a vessel with plane parallel sides. It will not be possible to observe the tiny irregular rotations of these crystals with an optical system such as the eye or eye + microscope since such rotations will but correspond to a small bundle of light. When, however, the light falls on a matte surface tiny spots of light can be seen (and photographed) to execute zig-zag motions. An amplitude of vibration of 1 mm. was observed on a plate placed at a distance of 20 cm. from the crystal particles. This must correspond approximately to an angle of rotation for the crystal of $8' \times 9'$ and therefore, as the diameter of the crystal was 0·02 mm. to an actual displacement of one edge corresponding to another considered as stationary, of only 0·00005 mm. Specimens of photographs taken are presented.

A New Colour Test for Vitamin A.

THE reputed antimony trichloride test for Vitamin A due to Carr and Price, has at least two drawbacks:—(1) the initial blue colour that is produced is not stable, and therefore unreliable as a basis for the quantitative estimation of the vitamin, and (2) it is not specific for vitamin A as other carotenoids also answer the same colour test. Rosenthal and Erdélyi have by a simple modification of the Carr-Price reaction succeeded in developing a test, characteristic of vitamin A (*Biochem. J.*, 1934, **28**, 41). The method consists in using 0·5 per cent. freshly prepared solution of catechol in chloroform, in addition to the usual Carr-Price reagent. The mixture containing catechol, antimony trichloride and the vitamin A containing substance is immediately transferred to a water bath at 60°C. and warmed for one to two minutes. The blue colour first produced changes over to an intense violet red, which is more stable than the blue of the Carr-Price reaction. Carotenoids do not give this reaction. The intensity of the violet-red colour is proportional to the concentration of vitamin A and the reaction can therefore be employed for the quantitative colorimetric estimation of the vitamin using a 0·01 per cent. solution of potassium permanganate for comparison.

B. N. S.

The Separation of the Enzymes and Toxic Principles of the venom of *Crotalus adamanteus*.

RATTLE snake venom contains a proteinase and a cephalinase, two enzymes which are responsible for its anti-coagulant action on blood. Their separation from each other has for the first time been accomplished by Dunn (*J. Pharmacology and Exp. Med.*, 1934, **50**, 393) who has employed two distinct methods for the purpose. Fractional precipitation of the venom by subjecting a solution of the venom (in 1 per cent. sodium chloride) of pH 5·2 to a temperature of 85°C. removes the proteinase completely, at the same time causing little decrease in the cephalinase activity of the filtrate. A 20 per cent. urea extract of the coagulum, after dialysis, exhibits a slight proteoclastic activity. Cephalinase can be completely adsorbed by a somewhat aged preparation of Aluminium Hydroxide C. The author has made the interesting observation that whereas freshly prepared Aluminium Hydroxide C adsorbed both the enzymes quantitatively, the same preparation eight months old adsorbed only the cephalinase leaving the major portion of the proteinase in solution. The adsorbent twelve months after preparation failed to adsorb either of the enzymes. Aluminium Hydroxide A adsorbs both the enzymes,

which can be eluted from the adsorption by a phosphate buffer solution (pH 6·9) to which 25 per cent. of its volume of glycerol has been added.

B. N. S.

The Movement of Food Materials in the Cotton Plant.

THE growth of the cotton plant is a problem of immediate concern to the Indian agriculturist, as this country is the second largest in cotton production. Any research or investigation relating primarily to the development of this species is, therefore, of the utmost importance. Mason and Philis of the Cotton Research Station, Trinidad, have formulated tentatively their views on the translocation of food materials in this plant (*Emp. Cotton Grow. Review*, **XI**, 121, 1934). During the vegetative phase the mineral nutrients absorbed by the roots are transferred to the leaves along with the transpiration current. The roots receive carbohydrates from the foliage for their growth and development. Thus the leaves are not only the store-house of sugars but also of the bulk of the mineral salts and they further act as the distribution centre of these products to other parts of the plant. According to the authors, during the vegetative phase, storage of inorganic materials takes place in the roots, stems and leaves. In the reproductive stage the manufactured food materials are translocated to the developing bolls. During this period, absorption of minerals through roots is inhibited, the plant in consequence ceasing to function in course of time.

The mechanism of the translocation of food materials, chiefly organic, is rather interesting. The sugars in the leaves first travel to the fine veins, against a gradient and thence are translocated through the sieve tubes of the phloem region, which extends to the bolls and traverses the bark of leaf stalks, etc. Here the direction of translocation is not unidirectional. The more significant feature about the movement of sugars in the sieve tubes is the rapidity of transportation which is thousands of times greater than the movement due to physical diffusion, the mechanism of which is still obscure.

The distribution of mineral elements from the leaf is also through the phloem, where the majority of them are mobile, but calcium and iron appear immobile. In the cotton plant, calcium does not appear to be present in the sieve tubes, while chlorine is largely available in them. It is useful to point out here that accurate micro-chemical analyses of the saps of the several tissues only can help in the examination of these materials. By their ringing tests, the authors have produced evidence of leakage of potassium, magnesium and chlorine into the woody tissues, and that these do not accumulate in the portion above the ring.

Flowback of minerals during the later stages of development is the view of physiologists and the same is gaining ground day by day. The authors have further shown that such flowback is evident from the corolla of flowers when these change colour from yellow to red.

The views put forth above are only tentative and call for critical examination at the hands of physiologists. It seems necessary to add that methods of micro and ultra-micro nature need to be evolved for testing saps and tissues of comparatively small dimensions.

V. I.

Coffee and Human Efficiency.

IT is not uncommon to find that coffee is either lauded or berated vigorously, in its relation to human efficiency. The subject is so old and in spite of the controversy, its consumption is only on the increase. The scientific aspect of coffee in the diet has not been lost sight of by investigators. Unlike other researches which relate to the administration of coffee and beverages from coffee on pathological conditions, R. C. Cheney (*J. Amer. Pharm. Assoc.*, **23**, 143, 1934) has devoted his attention to the physiological effect of coffee on human subjects of normal health. Opinion is generally divided as to the efficacy of coffee in improving muscular function, but in the present instance, evidence is adduced of positive effects in that direction. Among other things, the following factors were studied: blood pressure variations, respiration and time for recovery after fatigue. The experiments were carried out under identical conditions, with the treatment either with hot water, black coffee or caffeine in hot water, as the variable. Prior to the fatigue test the several drinks mentioned above were administered and the actual test consisted in lifting weights every ten seconds to complete fatigue. It was found that the work done was least in non-treated or hot water treated days and most in caffeine days, with that on the coffee day

lying in between the two. As regards blood pressure, no variations were noticed, while an increased respiratory activity in the coffee treatment indicated a greater oxygen consumption. This latter activity is related to intercranial pressure, decreasing the rate of cerebrospiral fluid secretion. Evidence has already been presented on the increased salivary secretions in volume per unit volume as a result of coffee drinking. Professor Hollingworth has reported a clearly distinguishable stimulation of the mind due to coffee. Thus there is sufficient evidence to say that coffee invigorates the brain and other parts of the central nervous system. Caffeine in coffee is less effective —probably due to the presence of other substances in the same—than separately. Fatigue is delayed.

But it must not be assumed from this that coffee can replace other foods in the normal course. Although its stimulating action persists for a considerable length of time after consumption, it is at best an aid to human efficiency and can never be a substitute for body fuel. The increased efficiency is perhaps due to the simultaneous invigoration of both the circulation of blood and general respiratory metabolism. It is therefore advantageous to avail of this aid during moments of depression and fatigue.

V. I.

Polymorphic Phenomena and Crystal Structure.

AN interesting paper on this subject by Tom F. W. Barth appears in the April issue of the *American Journal of Science* (**XXVII**, Fifth Series, No. 160). The author starts with the following definition of polymorphism—"Polymorphism includes every possible difference encountered in the crystalline lattice of a substance of constant chemical composition, excepting homogeneous deformations," and then proceeds to classify the several polymorphic changes occurring in crystals into three groups:—(1) A complete alteration of the space-lattice with the formation of a new type structure. Since the type of structure is changed, this case could be referred to as polytypy. (2) A distinct change in the syngony (*i.e.*, geometrical symmetry) of the space-lattice although the atomic arrangement, density, or cleavage properties are so slightly affected that the type of structure is preserved and merely a new variant of structure is formed. Such differences in the syngony properties could be referred to as polysyngony. (3) A change in the physical properties without any change of the syngony of the lattice. A new variant of structure is thereby formed but the type is of course preserved. Such properties of a crystal could be referred to as polytropy. In the latter part of the paper the polymorphism of potash felspar has been specially treated. Notwithstanding the fact that apparently monoclinic alkali felspars composed of submicroscopically twinned triclinic units do occur in nature, it can be shown that potash felspar is trimorphous.

L. R. RAU.

Micro-Hardness of Minerals.

IN a recent number of the *American Mineralogist* (**19**, No. 4, April 1934), H. C. Hodge and J. H. McKay have given a brief account of their determination of what they call the 'micro-hardness' of minerals with the help of a special instrument called the microcharacter. The minerals comprising the Mohs scale of hardness have been specially selected for investigation and the data obtained have been tabulated as follows:

Mohs scale	Width of cut in Microns	Micro-hardness
1. Talc	93·6	1
2. Selenite	90·3	11
3. Calcite	8·8	129
4. Fluorite	8·4	143
5. Apatite	5·5	517
6. Orthoclase	3·2	975
7. Quartz	1·9	2700
8. Topaz	1·7	3420
9. Corundum (Var. Sapphire)	1·4	5300

The authors suggest that the microcharacter may be applied to a more complete study of the hardness of minerals, particularly in regard to (1) the hardness-changes produced by changes in composition; (2) the hardness-changes produced in variously oriented crystals in an aggregate; or (3) the study of hardness with a view to the identification of the components of aggregates.

L. R. RAU.

Science News.

Birthday Honours :—The names of the following distinguished scientists in India are found among the recipients of the awards:—

Knighthood.—Dr. Upendranath Brahmachari, Calcutta.

C.I.E.—Lt.-Col. H. H. King, I.M.S., Director, King Institute, Guindy, Madras; Dr. W. McRae, Director and Mycologist, Imperial Institute of Agricultural Research, Pusa.

Rao Sahib.—Mr. V. Muthuswamy Iyer, Lecturer in Agricultural College, Coimbatore.

Rai Sahib.—Babu Jogindranath Gosh, Professor of Chemistry, Greer Bhumihar Brahman College, Muzaffurpur.

* * *

Rao Bahadur B. Viswanath, now Agricultural Chemist to the Government of Madras, has been appointed Imperial Agricultural Chemist. He will shortly leave Coimbatore to take up his duties at the Pusa Research Institute. Pending permanent arrangements, Mr. P. V. Ramiah will act as Agricultural Chemist to the Government of Madras.

Dr. Hem Singh Pruthi, of the Zoological Survey of India, has been appointed Imperial Agricultural Entomologist.

The Imperial Agricultural Research Station, now located at Pusa, will be transferred to a suitable site in the vicinity of Delhi. It may be recalled that the buildings of the Pusa Institute suffered heavy damage during the last earthquake. It is estimated that the entire scheme for the transference will involve an expenditure of 30-40 lakhs of rupees.

* * *

Prof. F. N. Mowdawalla, who recently resigned his appointment as Professor of Electrical Technology in the Indian Institute of Science, Bangalore, has, we understand, been appointed Principal and Professor of Electrical Engineering of the University College of Engineering, Bangalore.

* * *

Agricultural Research in Bengal, 1932-33 :—During the year, five schemes of research financed by the Imperial Council of Agricultural Research were in operation. From the financial assistance received by the Imperial Council and the Empire Marketing Board, a comprehensive scheme of research on rice was started and it is expected that as a result improved strains of trade rice will soon be introduced in Western Bengal and the export of this class of rice will be stimulated. The other schemes sanctioned by the Imperial Council include Fruit Research Work at Krishnagar and investigations into the costs of cane cultivation and rotation of crops in certain districts of Bengal.

The cane-crushing mill, designed by the Agricultural Engineer, was further improved and it has now been possible to deal with a maximum of 44 maunds of cane per hour with 74 per cent. extraction.

Owing to continued trade depression and competition from outside, the sericulture industry in Bengal was in a condition of stress and the situation was aggravated by unfavourable weather conditions not only for the growth of mulberry but also for the progress of silkworms. Demonstrations and propaganda were carried out as usual and preventive measures for dealing with the outbreak of disease among silkworms were undertaken by the staff.

* * *

Provincial Economic Conference, 1934 :—The grave problems that have arisen as a result of depression in the prices and demand for primary commodities of the country and their effect on the agricultural classes calling for immediate action were discussed at a joint Conference consisting of provincial representatives held at Delhi from the 3rd to 6th April. Several subjects of vital importance to the country such as agricultural indebtedness, marketing of agricultural products, crop-planning, industrial research, economic surveys and statistics, etc., came up for discussion and important decisions were arrived at.

On the subject of marketing agricultural produce, the approved programme includes the appointment of central and provincial marketing surveys, the appointment of special committees for staple crops starting with oil seeds and tobacco; and work on grade standards under the direction of Imperial Council of Agricultural Research. In order to study problems involved in the preparation of dairy products for different markets, a Dairy Industry Institute which will include a laboratory for carrying out research on the physical and chemical properties of Indian milk and its reaction to the various forms of processing and transport under Indian conditions, will be attached to the Imperial Institute of Animal Husbandry and Dairying at Bangalore.

A conference of provincial Directors of Agriculture and land revenue officers will be convened at an early date in order to discuss programmes for the regulation of production in adjustment to demand.

The Government of India have also decided to establish a Central Intelligence Bureau whose functions will include collecting and disseminating industrial intelligence, assisting the organisation of industrial exhibitions in India, publishing bulletins relating to industrial research, assisting industrialists by giving advice and making suggestions as to the directions in which research should be undertaken, etc. The Bureau will be attached to the Indian Stores Department. The Government of India also propose to disburse grants for the promotion of industrial research in specified subjects whenever necessary. They have decided to give a grant for sericultural research and another grant for the encouragement of the hand-loom industry. Further information regarding the conference may be obtained from the *India Trade Journal* (1934, **CXIII**, 552-556).

* * *

Empire Forestry Association :—The annual meeting of the Association was held during the last week of May, at the South Africa House, London. In the course of his speech Sir Bhupendranath Mitra, High Commissioner for India, said that India had the distinction of being the first unit in the Empire to develop scientific forestry; the forest service, as a trained service, was started in India as early as 1856 and since then the Government of India have placed the conservation of forests in the forefront of its policy. It may be pointed out that next to Canada, India is the

largest forestry country in the world with an area of about 300,000 sq. miles under timber. It is the principal source of fine quality timber in the Empire.

Sir Bhupendranath Mitra (High Commissioner for India), Lord Stonehaven, Mr. J. G. McLaven (Official Secretary for Australia), Mr. W. McAdam (Acting Agent-General for British Columbia) and Mr. J. D. Smith were elected to the Governing Council of the Association.

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Cotton Research in the Punjab:—The Indian Central Cotton Committee has undertaken a scheme for experiments on defibrating and delinting cotton. The seed of the long staple cotton grown in the Punjab is difficult to dispose of as they are fuzzy, and are supposed to be unsuitable as cattle feed. Consequently they fetch a very low price on the market. Comparative feeding trials conducted by the Agricultural Chimist at Lyallpur have shown that the fuzzy seed produced no harmful effects at all and cattle fed on those seeds thrived just as well as those fed on naked-seeded cottons.

* * *

Rockefeller Institute of Public Health for Japan:—Arrangements have been made for establishing an Institute of Public Health at Tokyo, attached to the Imperial University. It is proposed to build two hospitals one at Kyobashi-Ku, Tokyo, for the training of students and another at Tokorozawa. It is expected that the construction of the proposed buildings will take two years.

* * *

Manufacture of Steel in Mysore:—The Board of Management of the Mysore IronWorks, Bhadravati, have recommended to the Government the advisability of undertaking steel manufacture. The concern at present blasts only pig iron suitable for foundry purposes and according to the opinion of competent experts the addition of a steel plant will help to produce readily saleable articles and go a long way in stabilising the position of the Works. It is hoped that the Government will give effect to the recommendation of the Board.

* * *

Bee-rearing in Mysore:—The Department of Agriculture in Mysore is now taking a keen interest in the honey industry and is carrying on propaganda in favour of bee-keeping industry as a subsidiary occupation for farmers, particularly in the western districts of the State enjoying very favourable natural advantages. The State is now importing honey from Europe, Australia and New Zealand and encouragement of an indigenous industry, now in a primitive condition, is expected to make the State self-sufficient.

* * *

Fresh earthquake tremors of slight intensity are being reported in the Himalayan regions which experienced a disastrous earthquake on the 15th January last. Raxaul, Dacca, Agartala and Sylhet reported earthquake shocks on the 2nd June and a few villages in Nawabshaw district are reported to have felt shocks on the 4th June.

A terrible tornado swept over Sylhet on the 13th April, resulting in severe losses to life and property. Thousands of houses were blown out and several villages entirely wiped off. Jaldhup area alone has reported fourteen deaths.

* * *

Professor Wadia of the Wilson College, Bombay, and President of the Indian Inter-University Board, will shortly sail for America on a lecture tour. The Professor's object is stated to be "to interpret the soul of India for the benefit of Americans and to promote a better understanding between the peoples of the two countries". He will address several universities and associations all over the country, mainly on cultural subjects.

* * *

Spontaneous Ignition of Jute:—The causes of frequent occurrence of fires in jute cargoes destined for American ports, is now being investigated by the United States Bureau of Standards. As a first step the susceptibility of jute to spontaneous heating from microbial growth and from vegetable and animal oils spread over the jute was studied. The results have shown that self-heating resulting in ignition can be obtained consistently with linseed oil and menhaden oil on jute starting with spread initial temperatures in the range of 36°—50°. The factors favouring heating and ignition include optimum percentage of oil to fibre and thorough coating of the fibre with oil. The density and size of the sample were also found important, as well as the surrounding temperature and air supply.

* * *

All-Glass Buchner Funnels:—Amongst the apparatus recently introduced, the All-Glass Buchner Funnel is perhaps the most useful to the chemist. With the porcelain Buchner it was not possible to ascertain whether the surface below the filter plate was clean. Further the small size of the holes in the filter plate did not permit rapid filtration. These and other disadvantages have now been overcome in the new "All-Glass" Buchner Funnel, available in five different sizes. This new innovation cannot fail to commend itself to the routine as well as the research Chemist.

* * *

Reagents for Spot Tests:—Messrs. The British Drug House, Ltd., have recently put on market all the organic reagents useful for detecting and estimating small quantities of metals and other inorganic substances. The reactions can be carried out in a micro test tube, on a white tile with depressions for drops, on filter paper impregnated with the reagent and dried or on microscopic slides.

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The International Congress of Anthropological and Ethnological Sciences is to be held in London at the end of July and H. R. H. the Duke of York will welcome the scientists from all parts of the world who are expected to attend the session. Dr. B. S. Guha, Anthropologist, Indian Museum, Calcutta, has been officially invited to attend the function and this honour is a fitting tribute to his important publications on the scientific study of the Indian races in their applications to their social and economic development, their religious and superstitious practices and their customs and manners. We have pleasure in congratulating Dr. Guha on the distinction conferred upon him and we have no doubt that his contributions will bring credit to India.

* * *

We acknowledge with thanks the receipt of the following:—

"Nature," Vol. 133, Nos. 3363 to 3366.
"The Chemical Age," Vol. 30, Nos. 772 to 775.
"Canadian Journal of Research," Vol. 10, No. 4.
"The Journal of Chemical Physics," Vol. 2, Nos. 3 and 4.
"Berichte der Deutschen Chemischen Gesellschaft," Vol. 67, No. 4.
"Natural History," Vol. 34, No. 3.
"Journal of Agricultural Research," Vol. 48, Nos. 3 and 4.
"Experiment Station Record," Vol. 70, No. 3.
"American Journal of Botany," Vol. 21, No. 4.
"The Review of Scientific Instruments," Vol. 5, No. 4.
"The Mathematics Student," Vol. 1, No. 5 and Supplement to Vol. 1.
"Scientific Indian," Vol. 11, No. 65.
"Indian Forester," Vol. 60, Nos. 4 and 5.
"Medico-Surgical Suggestions," Vol. 4, No. 4.
"Forschungen und Fortschritte," Jahrgang, 10, Nos. 12 to 14.
"Journal of Agriculture and Livestock in India," Vol. 4, Part II.
"The Indian Journal of Veterinary Science and Animal Husbandry," Vol. 4, Part I.
"Indian Forest Records," Bulletin No. 82 (Sylvicultural Series), Vol. 19, Part IX—Entomological Investigations on the Spike Disease of Sandal (19)—On the Life-History and Morphology of *Petalocephala nigrilinea* (Jassidæ Homopt).
"The Indian Trade Journal," Vol. CXIII, Nos. 1454 to 1458. Department of Commercial Intelligence and Statistics, India—Monthly statistics of the production of certain selected industries of India, February 1934, No. 11 of 1933-34.
"Actualites Scientifiques et Industrielles," Nos. 89 to 93 and Nos. 130 to 132.
16th Annual Report of the National Research Council, Canada.
"Records of the Indian Museum," Vol. 36, pp. 123 to 138, Part I,—Worship and Propitiation of Wild Animals at Uttarbhag.

Reviews.

A BIBLIOGRAPHY OF SIR JAMES GEORGE FRAZER, O. M. By Theodore Besterman. (Macmillan & Co., Ltd., xxi + 100 pp.) Price 12*s.* 6*d.* nett.

It was indeed a very happy idea of the many friends and admirers of Sir James George Frazer to have thought of publishing a beautiful Bibliography of his works as an expression of their regard and esteem on the occasion of his celebrating the 80th anniversary of his birth. With the kind co-operation of several prominent men and public institutions with whom Sir J. G. Frazer was associated in the course of his work, Theodore Besterman has, by his diligence, patience and skill, been able to give us a lucid Bibliography of the numerous published writings of this great worker in the field of social anthropology; and there is no doubt that this valuable reference book will ever be a source of inspiration and guidance to other workers in this field. A beautiful recent photograph of Sir James Frazer adorns the book as a frontispiece.

L. RAMA RAO.

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ELECTRICAL ENGINEERING PRACTICE. By J. W. Meares and R. E. Neale. Vol. III, Fourth Edition, 1933. (Chapman & Hall.) 30*s.* nett.

Since the announcement by the authors some time back of their intention to bring out an additional volume of this very useful book, the electrical engineering profession has been looking forward to its publication. The volume now published fulfils the promise held out by the previous volumes and the authors are to be congratulated on the result of their labour. While there are excellent books dealing with the applications of electricity to individual classes of work, need has always been felt for a book covering the entire field of utilisation of electricity for diverse purposes, and the want has been very well filled by this new publication. As in the previous volumes the authors have aimed at making it practical and have with that object inserted a large number of tables containing very useful technical and cost data. Moreover, separate chapters on specification, testing and law have been included at the end of the book. While it should prove of great use to the engineer, it should also be very useful to advanced students as a text-book for the industrial applications of electricity.

Most of the matter in this volume is new and what little has already appeared in the previous volumes has been thoroughly revised and re-written. The book is well written, complete and up-to-date, and should find a place on the book shelf of many engineers. It is written for the purpose of meeting the needs of a wide circle of readers and fulfils the purpose satisfactorily. We whole-heartedly recommend it as a useful addition to the library not only of electrical engineers but also of

consulting engineers specialising in other branches of engineering.

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A TEXT-BOOK OF INORGANIC CHEMISTRY FOR UNIVERSITY STUDENTS. By J. R. Partington, M.B.E., D.Sc. (Fourth Edition, 1933, 1062 pp.) Price 15*s*. nett.

As with the older editions the fourth edition has kept pace with the growing development of the subject both in the theoretical and experimental side. The main alterations, as the author states in the preface, are the transfer of the section on Werner's theory from the end of the last chapter to the more fitting position in Chapter XXV where the discussion has been amplified by the introduction of topics like *chelate* and *dentate* groups and Electronic Theory of Co-ordination Compounds, references to the modern topics like heavy hydrogen isotope, neutron, etc., a general discussion on the hydride of elements and a revision of the section on active Nitrogen. The most interesting feature from the standpoint of the student of modern inorganic chemistry has been the application of the electronic theory of valency to the elucidation of the structure of compounds. Quite a number of the electronic formulæ of compounds has been introduced in place of the graphic formulæ and this is really a very happy departure from the older method of representing the structure of compounds. A table of the electronic structures of the rare earth elements has also been included.

Much attention has been paid in the book to the treatment of various physico-chemical principles, which are very necessary for an easy assimilation and rational understanding of the hard facts of descriptive chemistry.

There is also a collection of typical questions and problems at the end of the book, most of them being selected from the question papers of the British and Indian Universities. The fourth edition on the whole is a very good production and is very valuable as a text-book for the B.Sc. and B.Sc. Honours students of all Indian Universities. In fact the new edition will be welcomed with great pleasure by all students of chemistry.

M. SESHAIYENGAR.

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THE BEHAVIOUR OF ANIMALS: An Introduction to Its Study. By E. S. Russell, D.Sc., F.L.S. (Edward Arnold & Co., London. 180 pp. 1934.) Price 10*s*. 6*d*. nett.

Psychology has developed a new department of study devoted to the investigation of behaviour; and the habits of animals, especially those of gregarious animals, hold an irresistible attraction. The main reason of this fascination is that in the unforgotten depths of our consciousness, there are glimmerings of animal instincts which find an apposite expression in the life activities of the lower organisms and when we come to the more advanced creatures like the Anthropoid Apes, the similarities of behaviour become deeper and more numerous. All works on Natural History are popular and the work of Russell maintains the high traditional interest.

The Mechanistic School of biologists who try to reduce the life activities of animals to the forces of physical and chemical laws of interactions, fail to appreciate the value of the study of the animal in its wholeness and the mechanistic interpretation of the behaviour of animals fails to provide an adequate explanation for spontaneity, co-operation, emotional expressions and herd instincts of animals. The book provides the technical readers with a concise and authoritative information on the most fascinating subject and the general reader will find in it perennial interest. If such a reader were occasionally to find instances recorded in the book not conforming to his own observations, it must be borne in mind that the behaviour of animals under induced experimental conditions, in confined and strange situations, in the menageries and cages where they are exposed every day to human intervention, differ widely from that which they exhibit in their natural homes and haunts and in an atmosphere of their native freedom and seclusion. Very often most extravagant inferences and untenable general conclusions are attempted to be deduced from observations made on domestic animals which through long association with man and his environment, have become as sophisticated as their masters. The book sufficiently safeguards against all fallacies and makes clear the general principles on which the observations should be interpreted. We have read the book with delight and in our judgment it is an interesting chapter in scientific romance.

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MIMICRY. By G. D. Hale Carpenter, M.B.E., D.M., and E. B. Ford, M.A., B.Sc. (Methuen & Co. Ltd., 36, Essex Street, London, W. C. 1933. vii+124 pp.) Price 3*s*. 6*d*. nett.

This little book maintains the high standard which distinguishes the other monographs on biological subjects published by Methuen & Co., and the authors have achieved the difficult task of presenting within a short compass an authoritative exposition, free from technical terms, of a really difficult branch of biological studies. The phenomenon of mimicry is not confined to any group of animals but like joy in widest commonalty spread. The study of mimicry cannot be studied as an isolated fact, but is part of the wider phenomena of colouration and habit. The book, however, deals with the several aspects of mimicry as exemplified by the arthropods especially the groups of insects and spiders and omits reference to the less well understood cases of mimicry among the vertebrated animals.

The theory of mimicry is based on solid foundations and the causes of mimetic resemblance are the very causes of evolution also. Therefore the principle of Natural Selection provides a satisfactory explanation not only of the origin and significance of the general facts of colouration, but also of its special branch of schematic resemblances. The opening sentence which defines the phenomenon of mimicry, "the term mimicry implies the conscious assumption by one individual for his own purposes, of characters peculiar to other," would read better and perhaps would be correct without the word "conscious". The definition might seem to imply that the power of assuming resemblances is within the knowledge and under the volition of the animals concerned. They are no more responsible for their external appearances than for the possession of a complete set of internal organs. Nature imposes both on the animals perhaps, in spite of themselves and it is here that the whole animate world is completely under the dominating influence of some Power in Nature which they can neither compel nor control.

The subject of colouration of animals either from the standpoint of biological or physical sciences is fascinating to a degree and in the whole field of natural history, there is hardly any branch of knowledge more arresting than mimicry and behaviour induced by the adaptive modification of external features. The great merit of the book is that while it presents a complete and up-to-date information on the subject, it excites the curiosity of the reader to pursue his studies in the field and extend his knowledge by personal observation. Every chapter makes delightful reading and the serious student of biology and even the casual reader will find in this book great pleasure and profit. The diffusion of a correct knowledge of the biological theories and facts among a wider circle of readers has become an increasing necessity and books of the type of monographs, which Methuen & Co., have produced, serve a great educational purpose.

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CLASSIFIED CATALOGUE CODE. By S. R. Ranganathan. (Published by the Madras Library Association, pp. 296.) Price 10*s*. 6*d*.

The Classified Catalogue Code by Mr. S. R. Ranganathan is the fourth of a useful series of publications of the Madras Library Association. The rules for the indexing of books and periodicals have been dealt with in detail. Hints have also been given for dealing with Hindu, Muslim and other names, which will be very useful to librarians, especially in India. The Code contains also a scholarly note on Authorial Polyonymy and Homonymy in Sanskrit literature by Mahamahopadhyaya Vidyavachaspati S. Kuppaswami Sastriar, M.A., I.E.S., Professor of Sanskrit and Comparative Philology, Presidency College, Madras. A transliteration table for Sanskrit and Dravidian languages has also been introduced, which the author would have done well to use in the case of many entries in the Code. There are also a few mistakes and printer's devils in the book, such as Granta for Grantha (pp. 26 and 27), amudātta for anudātta (p. 28), Sarvapalli for Sarvepalli (p. 66), New for Neue (p. 273), which we hope will be corrected in the next edition.

K. A.

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VOCATIONAL EDUCATION IN MYSORE. By Dr. K. N. Kini. (Published by the Bangalore Press, pp. 205.) Price Rs. 2.

Plato laid down a fundamental principle of education when he asserted that it was the business of education to discover what each person is good for and to train him accordingly. To this we might add that the key to happiness is to find out what one is fitted to do in life and to secure an opportunity to do it. Speaking generally the purpose of Dr. Kini is merely to show the way to achieve this happiness in a practical way and to avoid the tragedy caused by people drifting into uncongenial callings by

force of circumstances. Dr. Kini has done this task most admirably. The intimate knowledge of facts which his previous experience in Mysore had given him, combined with a careful appraisal of conditions obtaining in the West has made it possible for Dr. Kini not only to present the problem of Vocational education as related to the State of Mysore but also to offer some practical suggestions which challenge the attention of those interested in the economic and educational rebuilding of our State. I have read his book with great interest and profit and I commend it most unreservedly to all students of education and more especially to those in authority in our State without whose patronage and generosity no forward step in Vocational education can be taken.

T. N. J.

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Dip and Strike Problems. By Kenneth W. Earle, D.Sc., F.G.S. (Thomas Murby & Co., London. x+126 pp.) Price 12*s*. 6*d*. nett.

Of the nine chapters in this book, the first five deal with the different aspects relating to the calculation of dip, strike, and thickness of strata, and the next three are devoted to the solution of problems involving faults and their effects on synclines and anticlines. The last chapter gives a brief account of the various mechanical devices like the 'Dip diagram', 'Oldham's graticule', 'Harker's protractor', etc. At the end there is a Glossary of structural terms and a useful Bibliography for the advanced student.

This book is obviously an expression of the growing tendency among some geologists to introduce strictly mathematical methods in the solution of problems in structural geology. Opinion has been divided on the desirability of such a tendency, and serious doubts have been expressed as to how far such methods will really enable the field geologist to tackle his problems in a more efficient manner and with more reliable results than before; and one is easily inclined to agree with the author of this book when he says "that any mathematical calculation connected with geological strata must be *per se* only approximate in accuracy."

Despite the realisation of this fact on the part of the author, there is no doubt that while writing this book he is still carried away by his enthusiasm to introduce mathematical methods in the solution of problems in structural geology; and the book under review bears ample evidence of the fact that he is very much enamoured of such 'mathematical' treatment and delights in straight away reducing all problems in structural geology to so many exercises in geometry and trigonometry.

L. Rama Rao.

Errata.

Page 435—Magnifications.

Fig. I	*for*	"×79" ..	*read*	"×32"
Fig. II	*for*	"×79" ..	*read*	"×32"
Fig. III	*for*	"×75" ..	*read*	"×31"
Fig. IV	*for*	"×75" ..	*read*	"×31"
Fig. V	*for*	"×30" ..	*read*	"×12"
Fig. VI	*for*	"×20" ..	*read*	"× 7"
Fig. VII	*for*	"×20" ..	*read*	"× 8"

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